FIG. 1

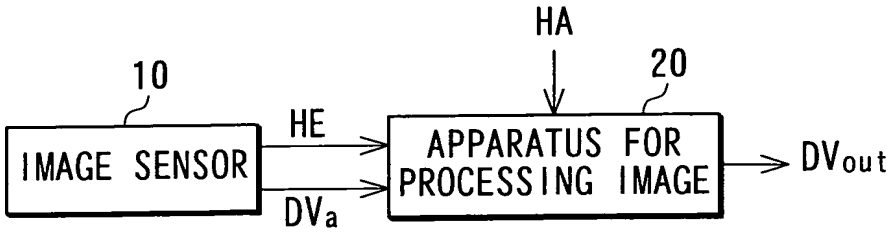
HA
10
20
IMAGE SENSOR
HE
DVa
APPARATUS FOR PROCESSING IMAGE
DVout

FIG. 2

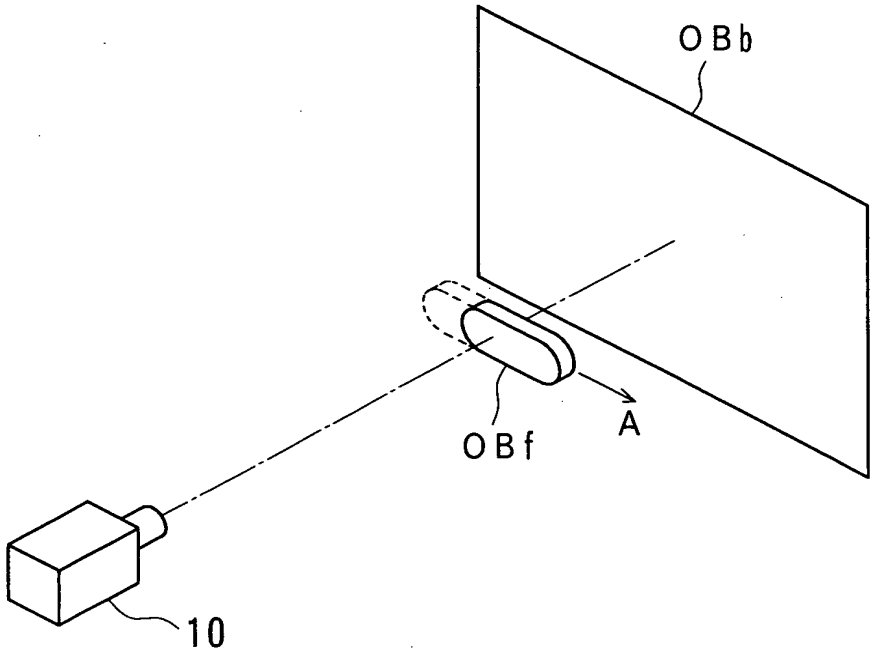
OBb
OBf
A
10

FIG. 3A

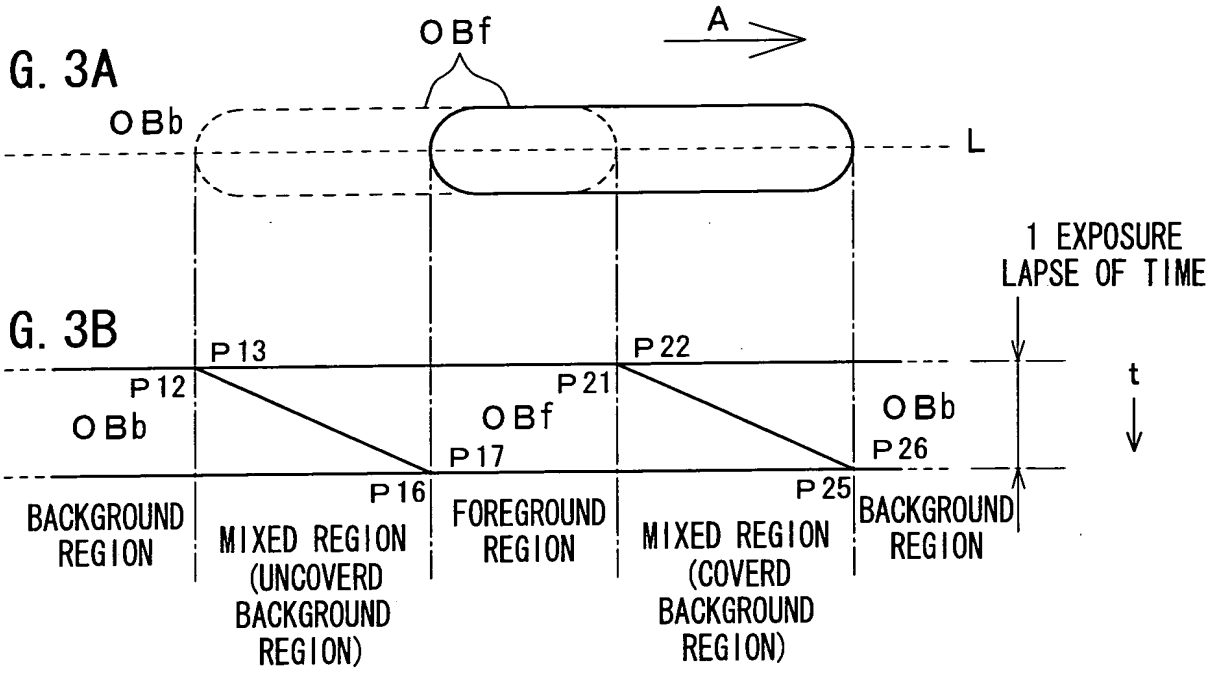

FIG. 3B

FIG. 5

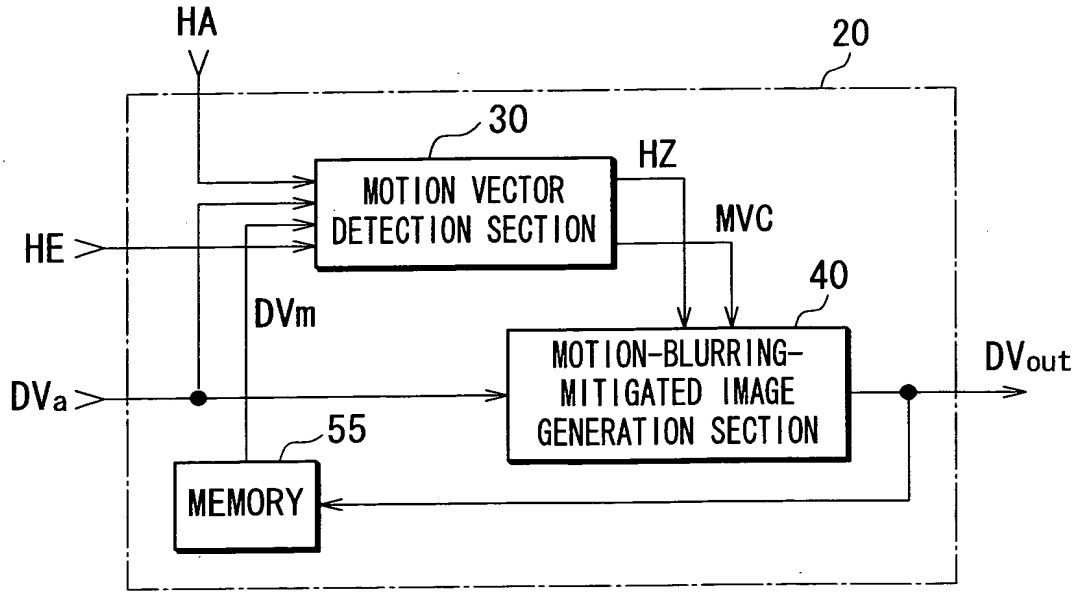

FIG. 4

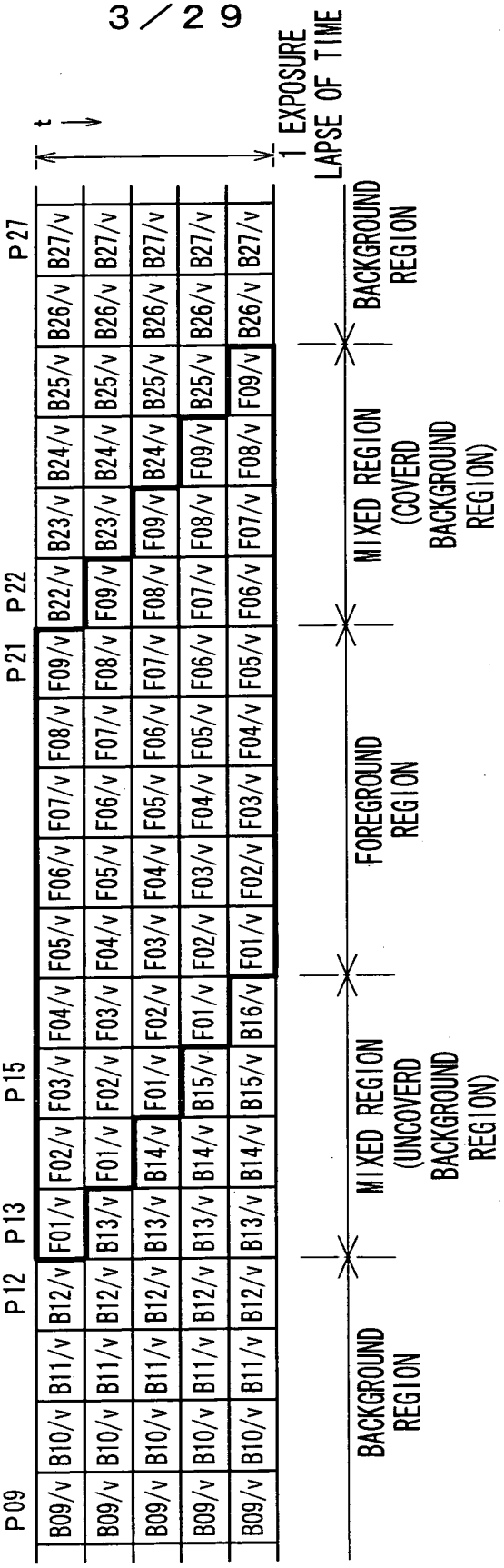
1 EXPOSURE LAPSE OF TIME
t
P09
P12
P13
P15
P21
P22
P27
BACKGROUND REGION
MIXED REGION (UNCOVERD BACKGROUND REGION)
FOREGROUND REGION
MIXED REGION (COVERD BACKGROUND REGION)
BACKGROUND REGION

FIG. 6

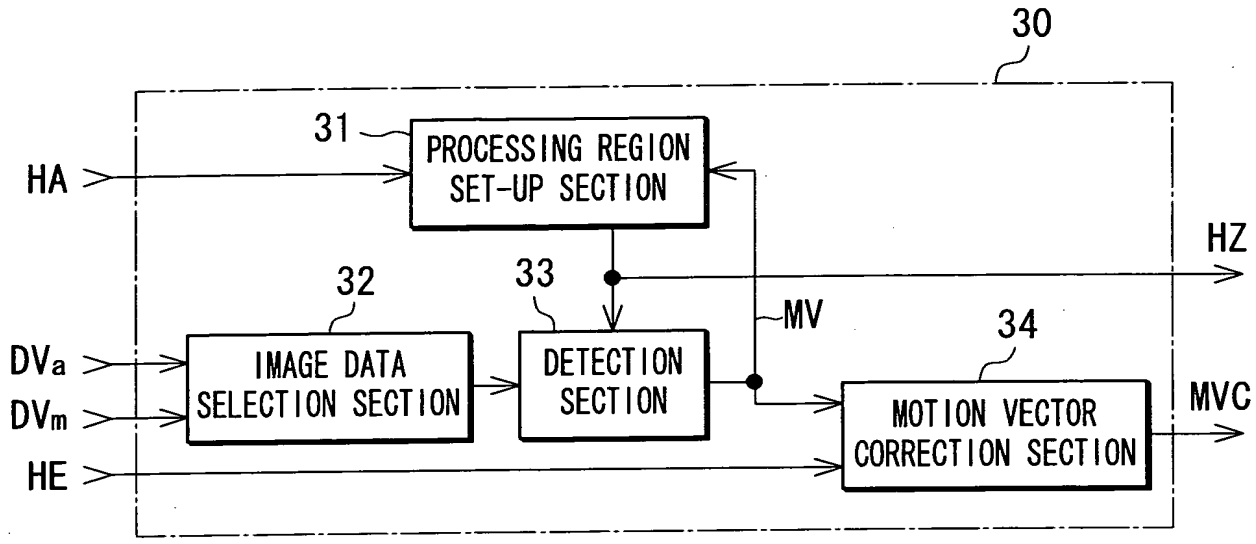
30
31
PROCESSING REGION SET-UP SECTION
HA
HZ
32
33
MV
34
DVa
DVm
IMAGE DATA SELECTION SECTION
DETECTION SECTION
MOTION VECTOR CORRECTION SECTION
MVC
HE

FIG. 7

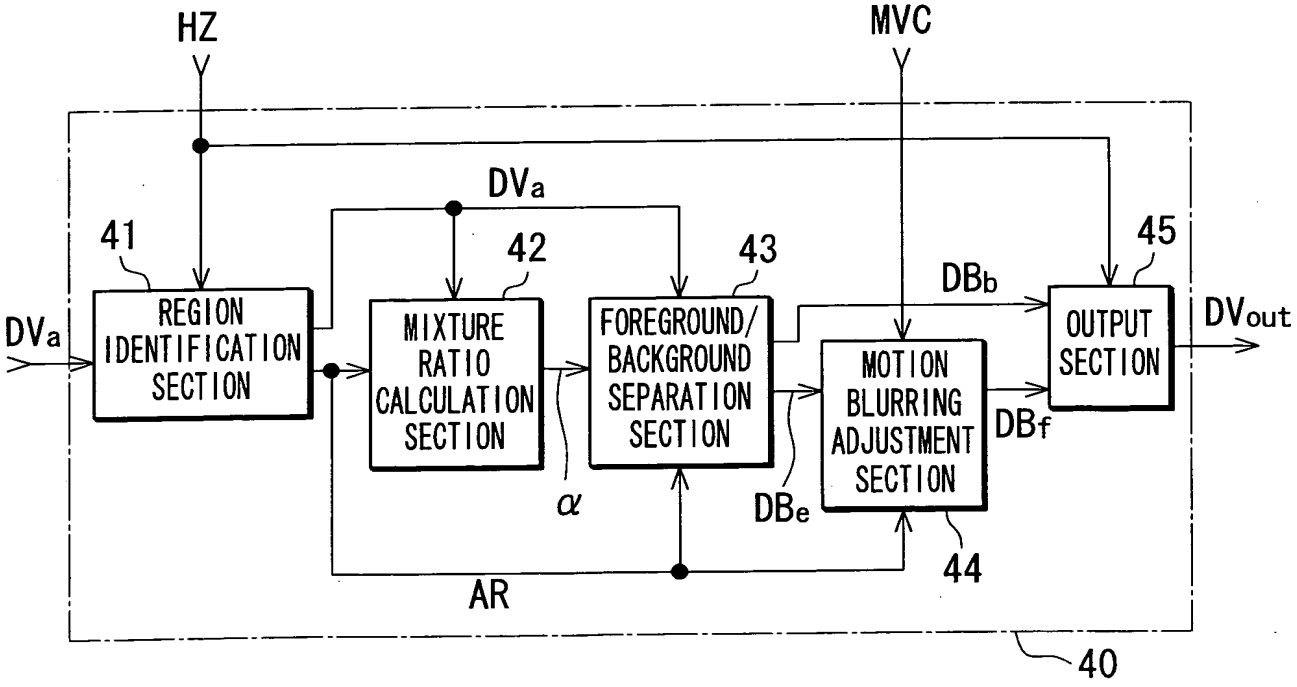
HZ
MVC
DVa
41
42
43
45
DBb
DVa
REGION IDENTIFICATION SECTION
MIXTURE RATIO CALCULATION SECTION
FOREGROUND/ BACKGROUND SEPARATION SECTION
MOTION BLURRING ADJUSTMENT SECTION
OUTPUT SECTION
DVout
DBf
α
DBe
44
AR
40

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FIG. 8

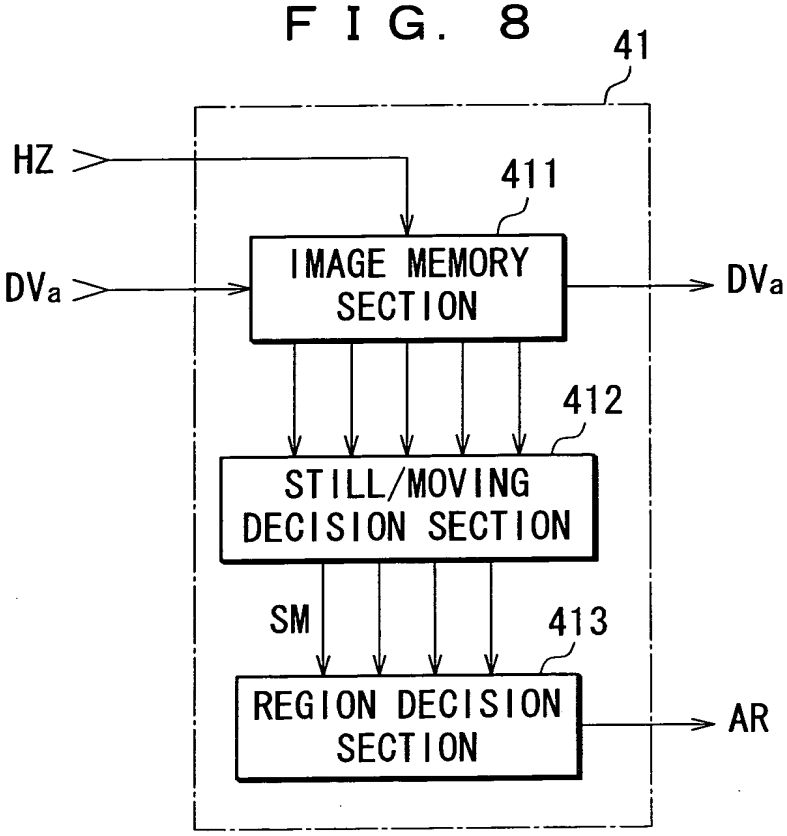


FIG. 10

REGION DETERMINATION	STILL/MOVING DECISION ON FRAMES #n-2 AND #n-1	STILL/MOVING DECISION ON FRAMES #n-1 AND #n	STILL/MOVING DECISION ON FRAMES #n AND #n+1	STILL/MOVING DECISION ON FRAMES #n+1 AND #n+2	DECISION LOGIC
STILL REGION		STILL	STILL		OR
COVERD BACKGROUND REGION	STILL	MOVING			AND
UNCOVERD BACKGROUND REGION			MOVING	STILL	AND
MOVING REGION		MOVING	MOVING		AND

FIG. 9

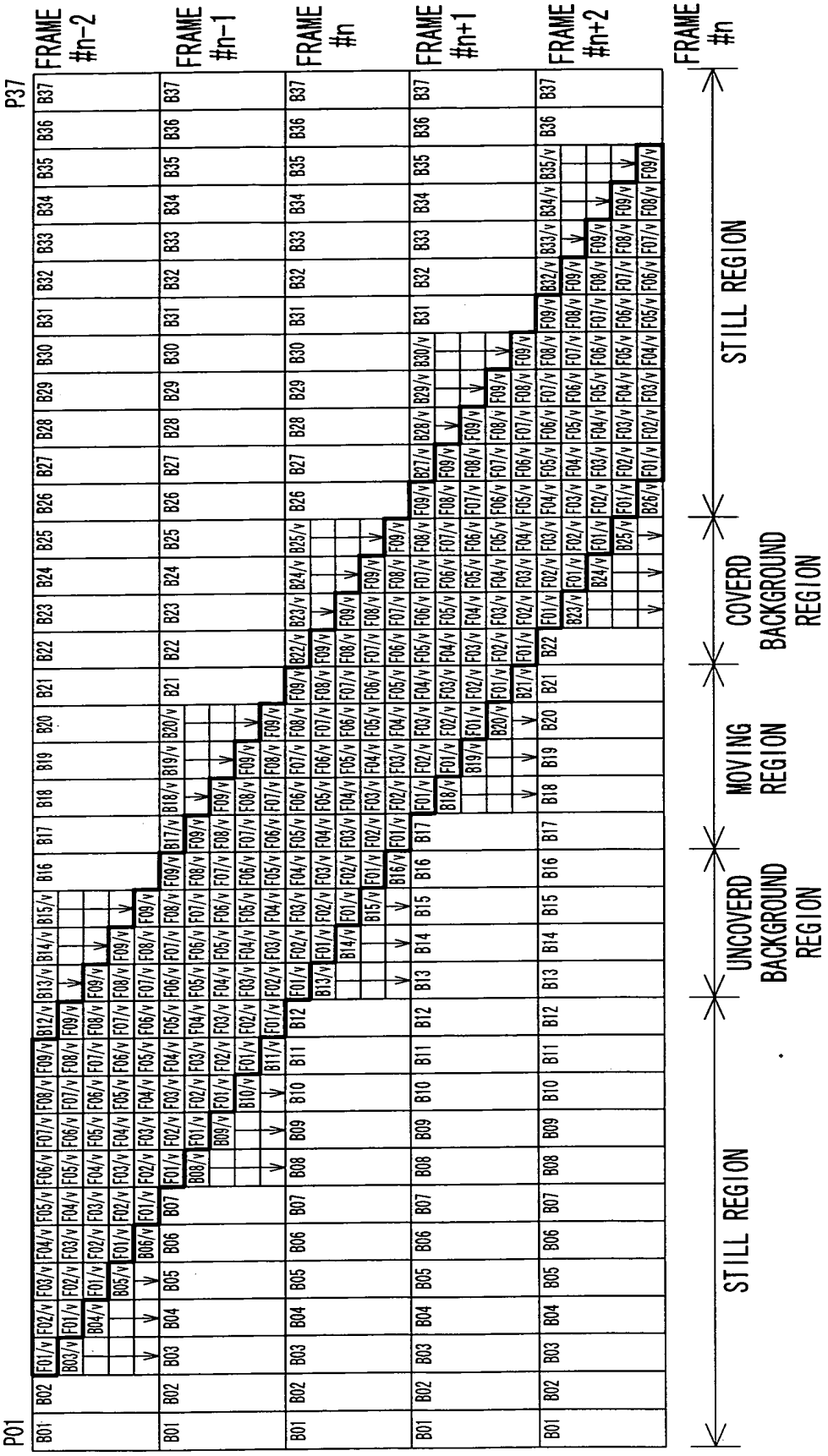

P01
P37
FRAME #n-2
FRAME #n-1
FRAME #n
FRAME #n+1
FRAME #n+2
FRAME #n
STILL REGION
UNCOVERD BACKGROUND REGION
MOVING REGION
COVERD BACKGROUND REGION
STILL REGION

FIG. 11

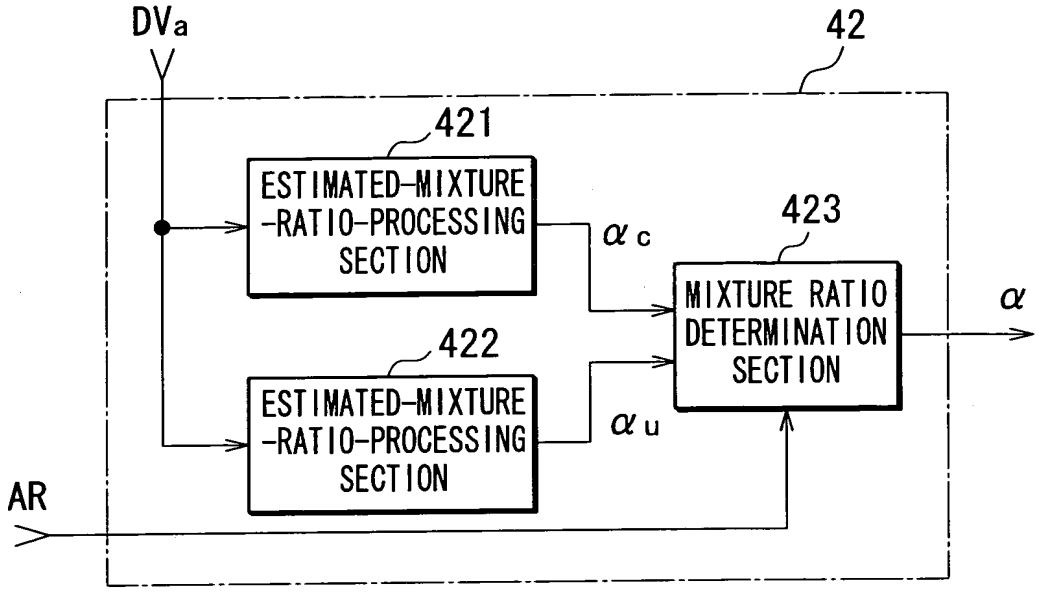

DVa
42
421
ESTIMATED-MIXTURE-RATIO-PROCESSING SECTION
αc
423
MIXTURE RATIO DETERMINATION SECTION
α
422
ESTIMATED-MIXTURE-RATIO-PROCESSING SECTION
αu
AR

FIG. 12

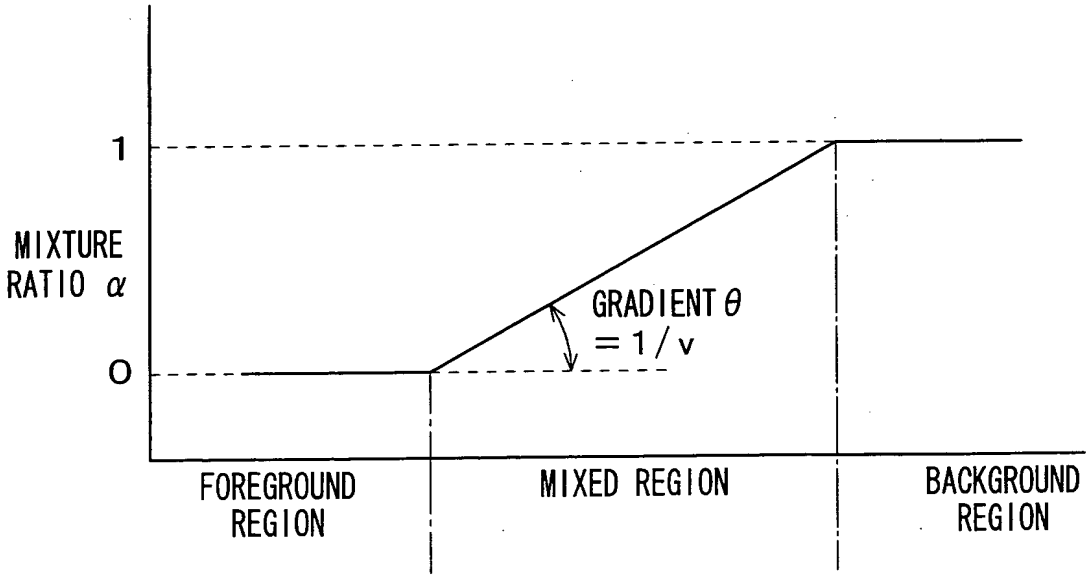

1
MIXTURE RATIO α
0
GRADIENT θ = 1/v
FOREGROUND REGION
MIXED REGION
BACKGROUND REGION

FIG. 13

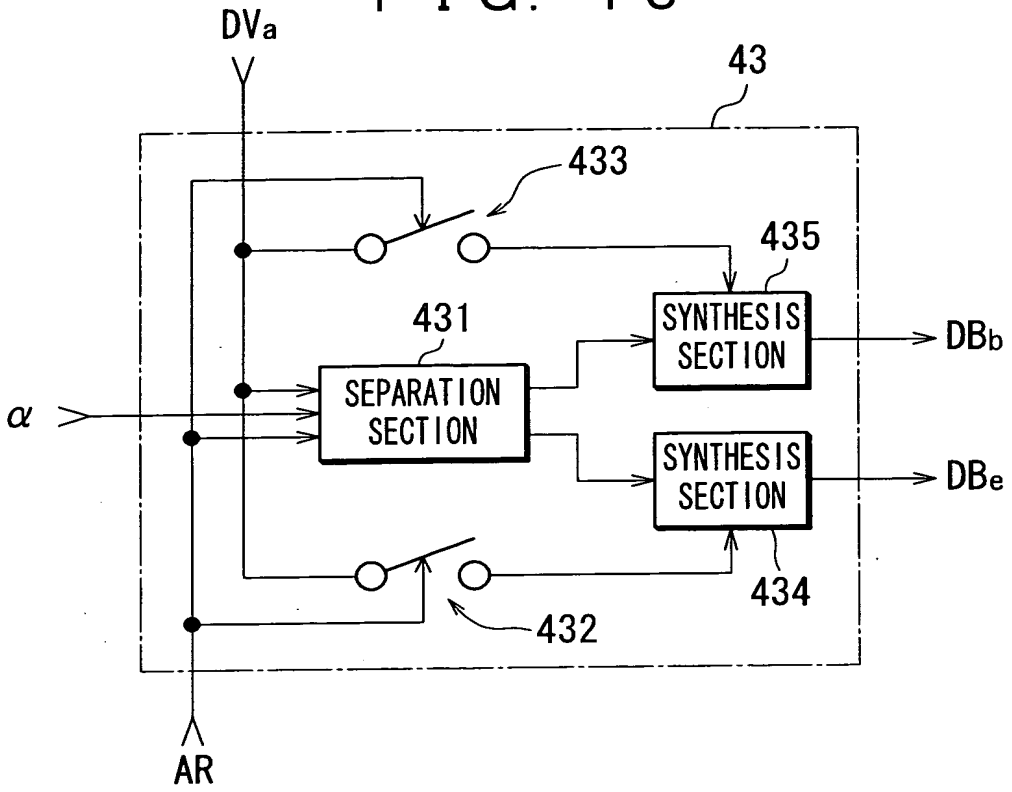
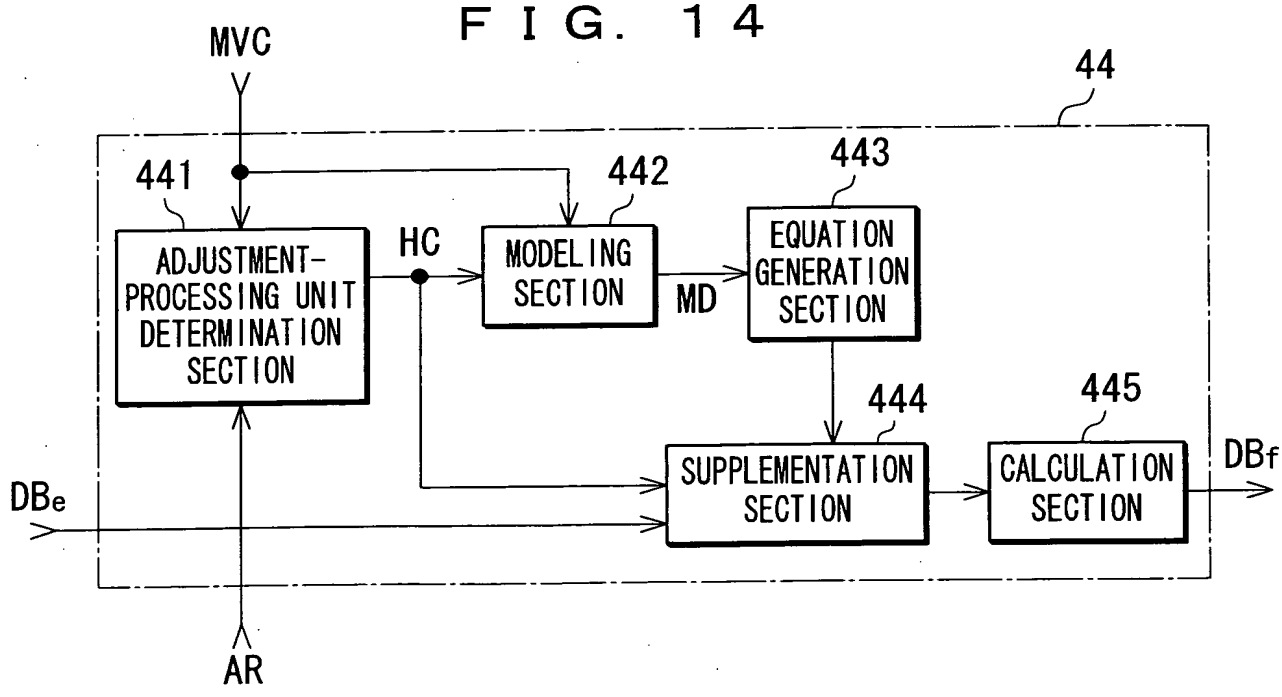

DVa
43
433
435
431
SYNTHESIS SECTION
DBb
α
SEPARATION SECTION
SYNTHESIS SECTION
DBe
434
432
AR

FIG. 14


MVC
44
441
442
443
ADJUSTMENT-PROCESSING UNIT DETERMINATION SECTION
HC
MODELING SECTION
MD
EQUATION GENERATION SECTION
444
445
DBe
SUPPLEMENTATION SECTION
CALCULATION SECTION
DBf
AR

10/552466

FIG. 15

F01/v	F02/v	F03/v	F04/v	F05/v	F06/v	F07/v	F08/v	F09/v					
	F01/v	F02/v	F03/v	F04/v	F05/v	F06/v	F07/v	F08/v	F09/v				
		F01/v	F02/v	F03/v	F04/v	F05/v	F06/v	F07/v	F08/v	F09/v			
			F01/v	F02/v	F03/v	F04/v	F05/v	F06/v	F07/v	F08/v	F09/v		
				F01/v	F02/v	F03/v	F04/v	F05/v	F06/v	F07/v	F08/v	F09/v	

C01 C13

FIG. 16

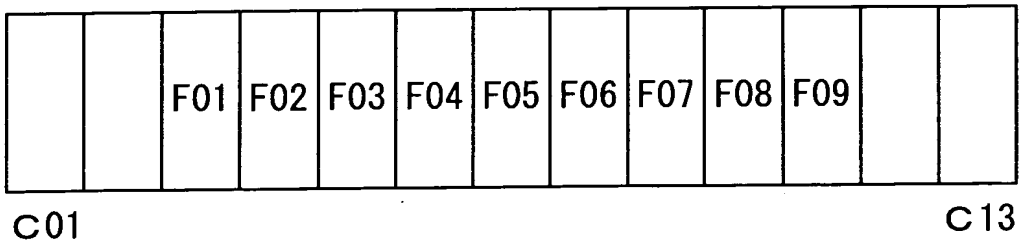

F01
F02
F03
F04
F05
F06
F07
F08
F09
C01
C13

FIG. 17

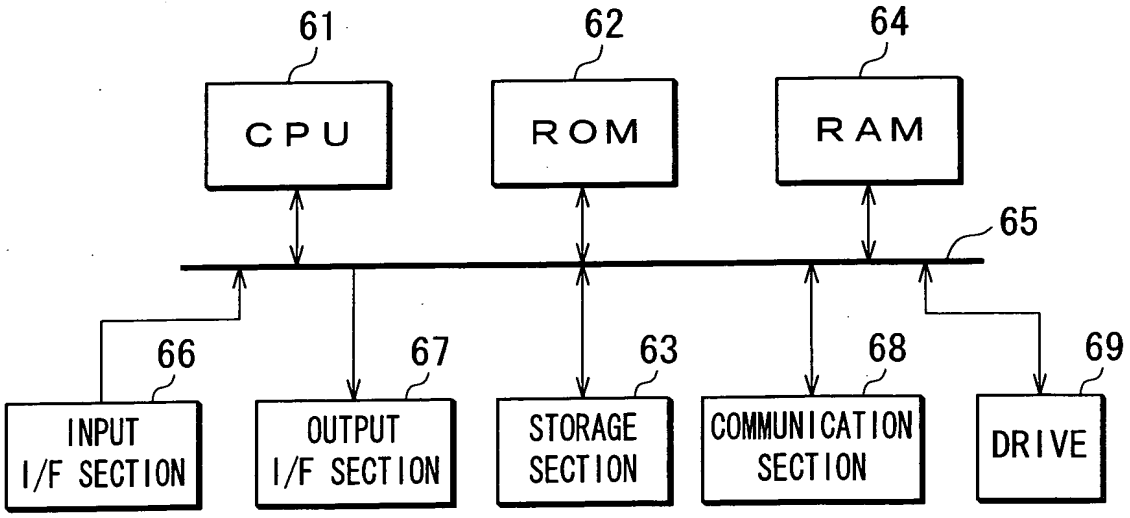

61
62
64
CPU
ROM
RAM
65
66
67
63
68
69
INPUT I/F SECTION
OUTPUT I/F SECTION
STORAGE SECTION
COMMUNICATION SECTION
DRIVE

FIG. 18

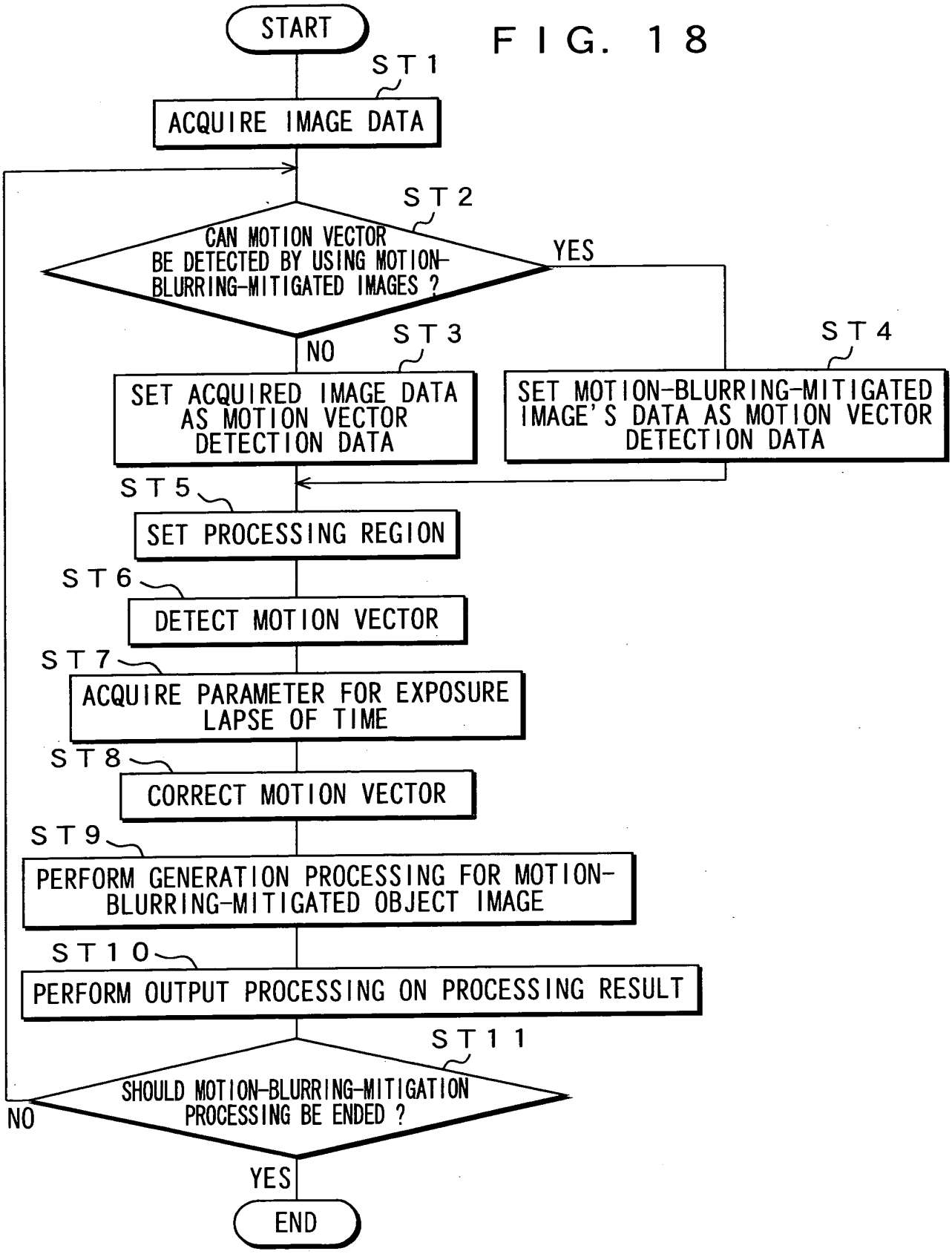

START
ST1
ACQUIRE IMAGE DATA
ST2
CAN MOTION VECTOR BE DETECTED BY USING MOTION-BLURRING-MITIGATED IMAGES ?
YES
NO
ST3
SET ACQUIRED IMAGE DATA AS MOTION VECTOR DETECTION DATA
ST4
SET MOTION-BLURRING-MITIGATED IMAGE'S DATA AS MOTION VECTOR DETECTION DATA
ST5
SET PROCESSING REGION
ST6
DETECT MOTION VECTOR
ST7
ACQUIRE PARAMETER FOR EXPOSURE LAPSE OF TIME
ST8
CORRECT MOTION VECTOR
ST9
PERFORM GENERATION PROCESSING FOR MOTION-BLURRING-MITIGATED OBJECT IMAGE
ST10
PERFORM OUTPUT PROCESSING ON PROCESSING RESULT
ST11
SHOULD MOTION-BLURRING-MITIGATION PROCESSING BE ENDED ?
NO
YES
END

FIG. 19

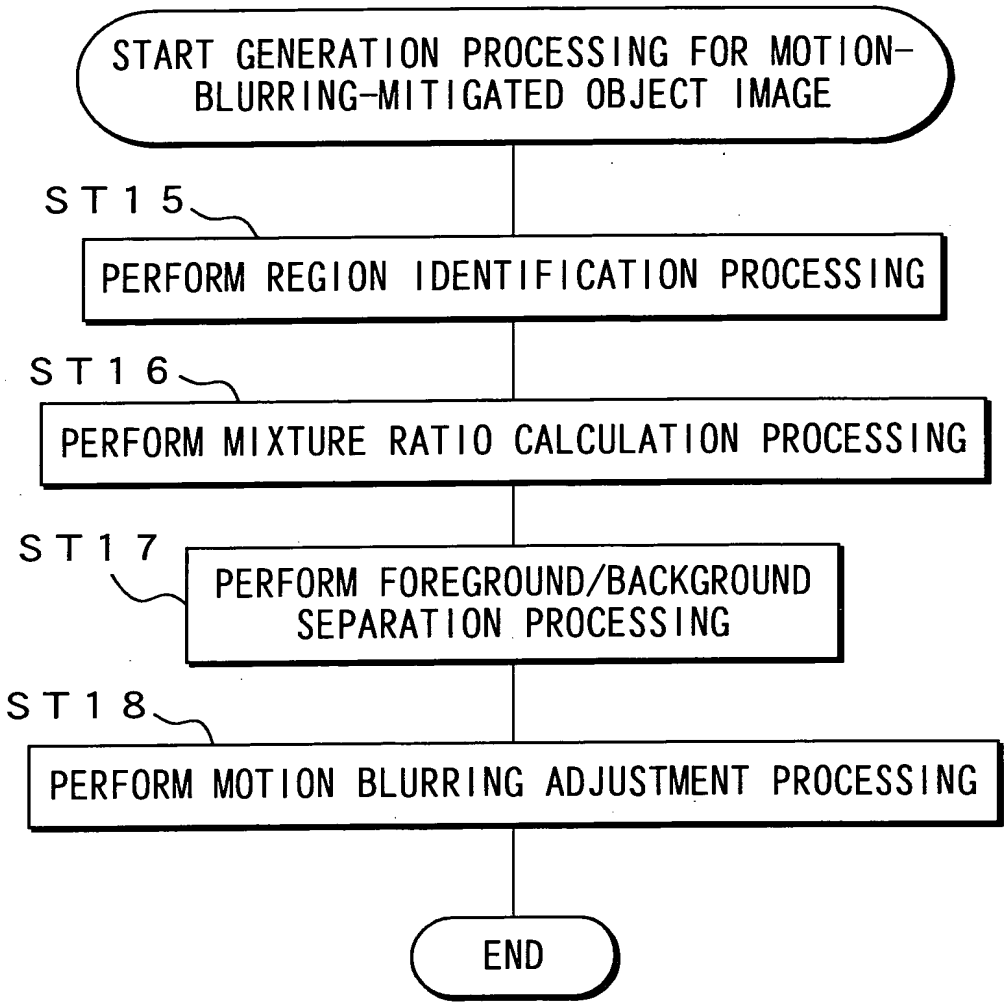

START GENERATION PROCESSING FOR MOTION-BLURRING-MITIGATED OBJECT IMAGE
ST15
PERFORM REGION IDENTIFICATION PROCESSING
ST16
PERFORM MIXTURE RATIO CALCULATION PROCESSING
ST17
PERFORM FOREGROUND/BACKGROUND SEPARATION PROCESSING
ST18
PERFORM MOTION BLURRING ADJUSTMENT PROCESSING
END

FIG. 20

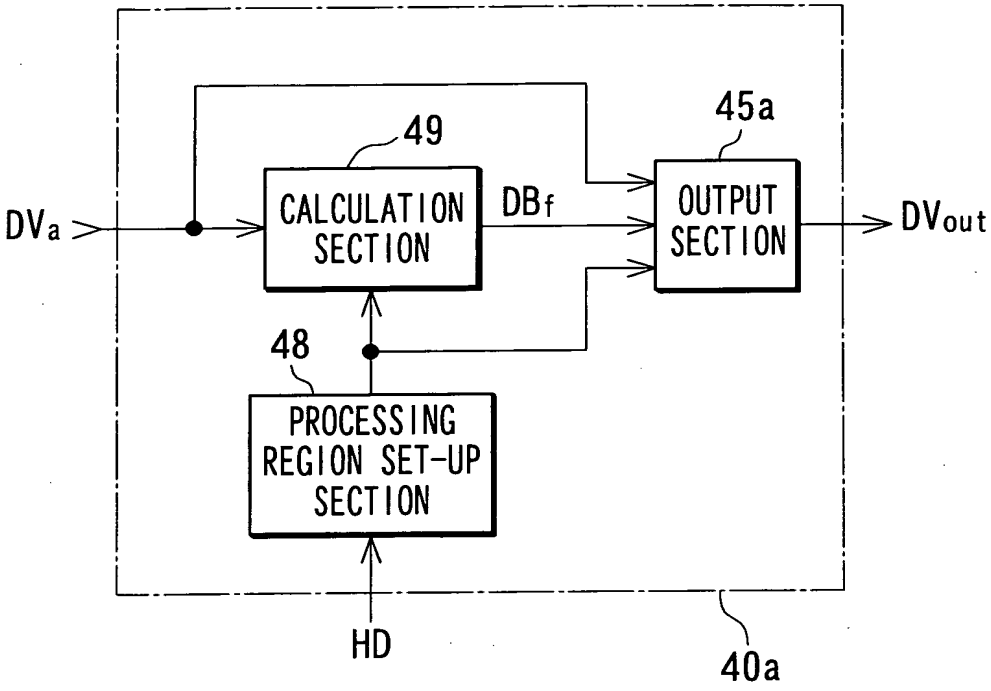

49
45a
DVa
CALCULATION SECTION
DBf
OUTPUT SECTION
DVout
48
PROCESSING REGION SET-UP SECTION
HD
40a

FIG. 21

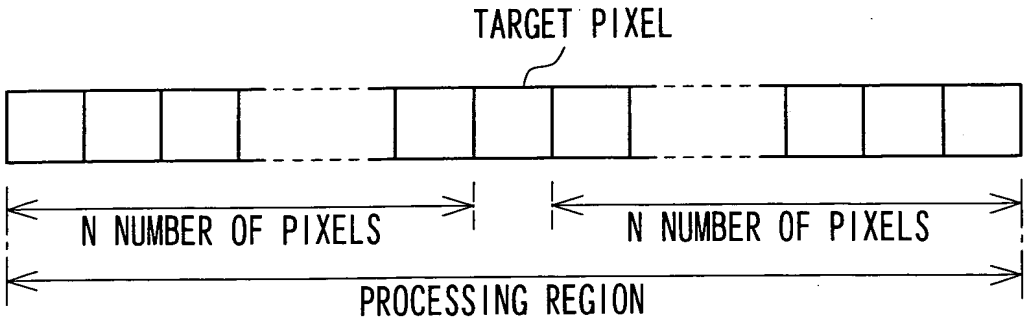

TARGET PIXEL
N NUMBER OF PIXELS
N NUMBER OF PIXELS
PROCESSING REGION

FIG. 22A

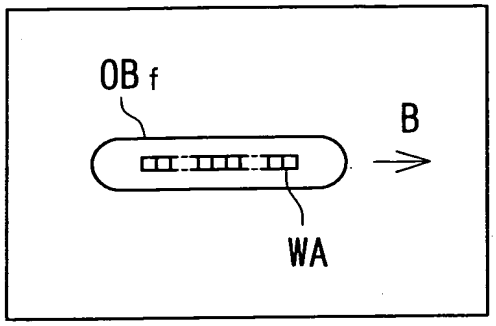


FIG. 22B

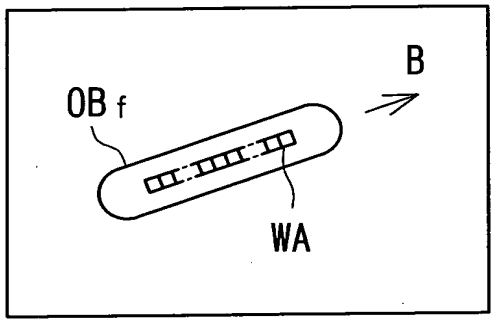
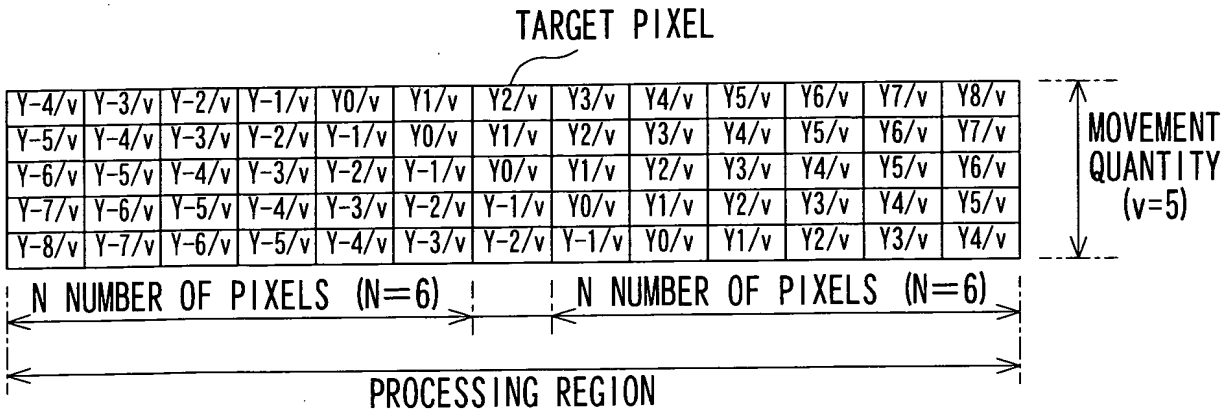


FIG. 23



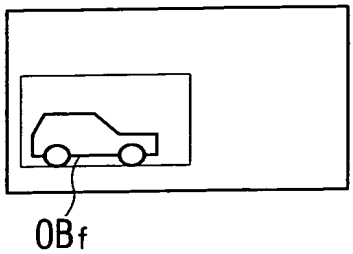


FIG. 24A

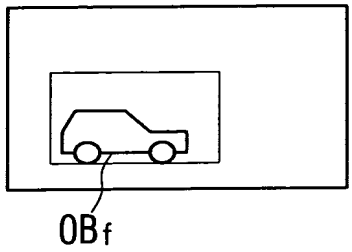


FIG. 24B

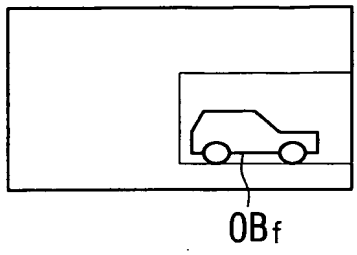


FIG. 24C

FIG. 25A

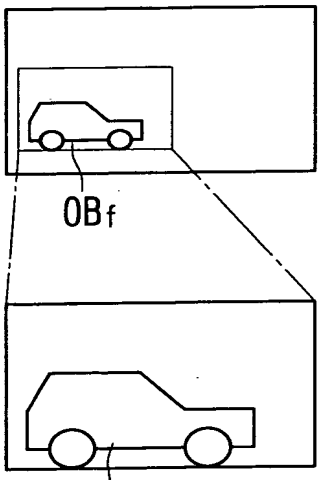


FIG. 25D

FIG. 25B

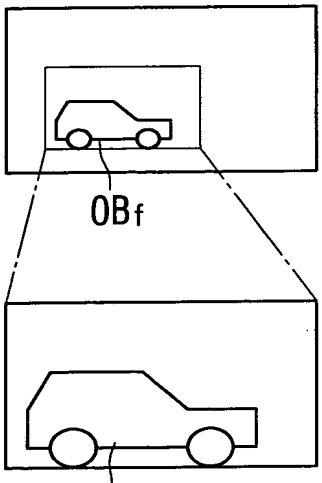


FIG. 25E

FIG. 25C

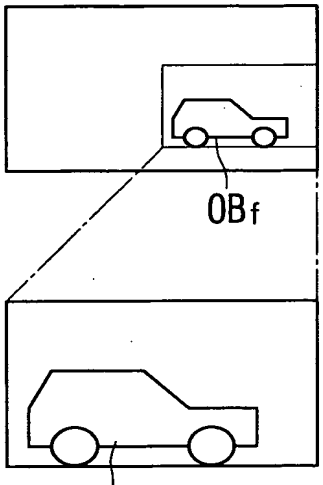


FIG. 25F

FIG. 26

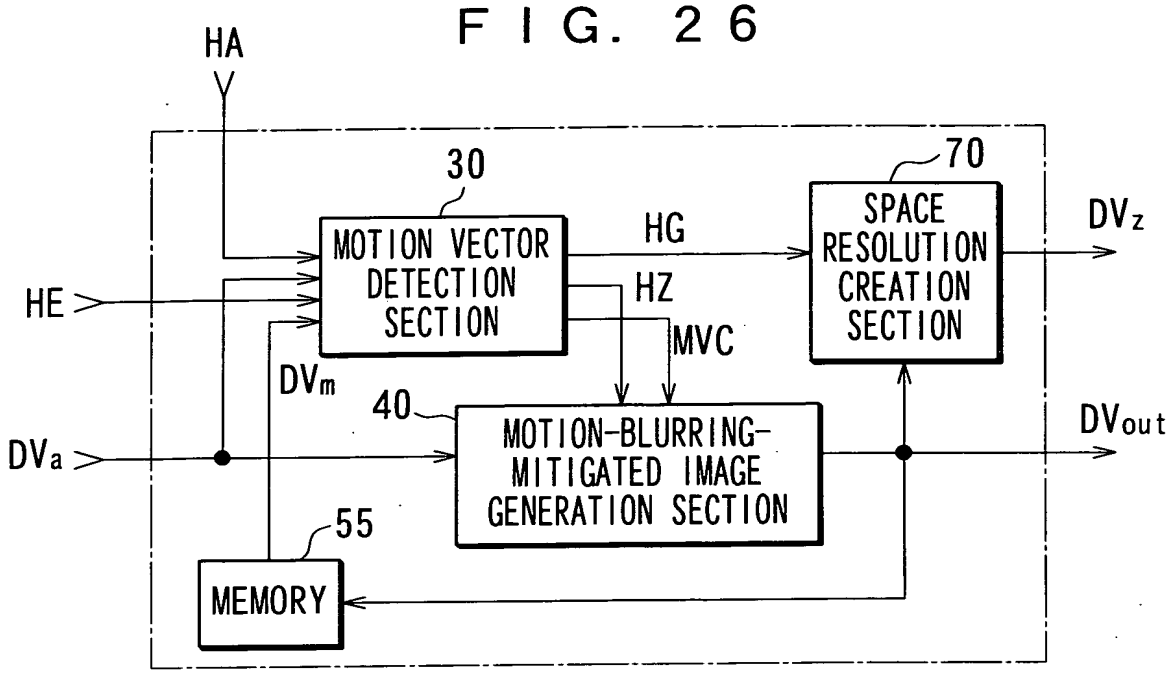

HA
30
70
MOTION VECTOR DETECTION SECTION
HG
SPACE RESOLUTION CREATION SECTION
DVz
HE
HZ
MVC
DVm
40
DVout
DVa
MOTION-BLURRING-MITIGATED IMAGE GENERATION SECTION
55
MEMORY

FIG. 27

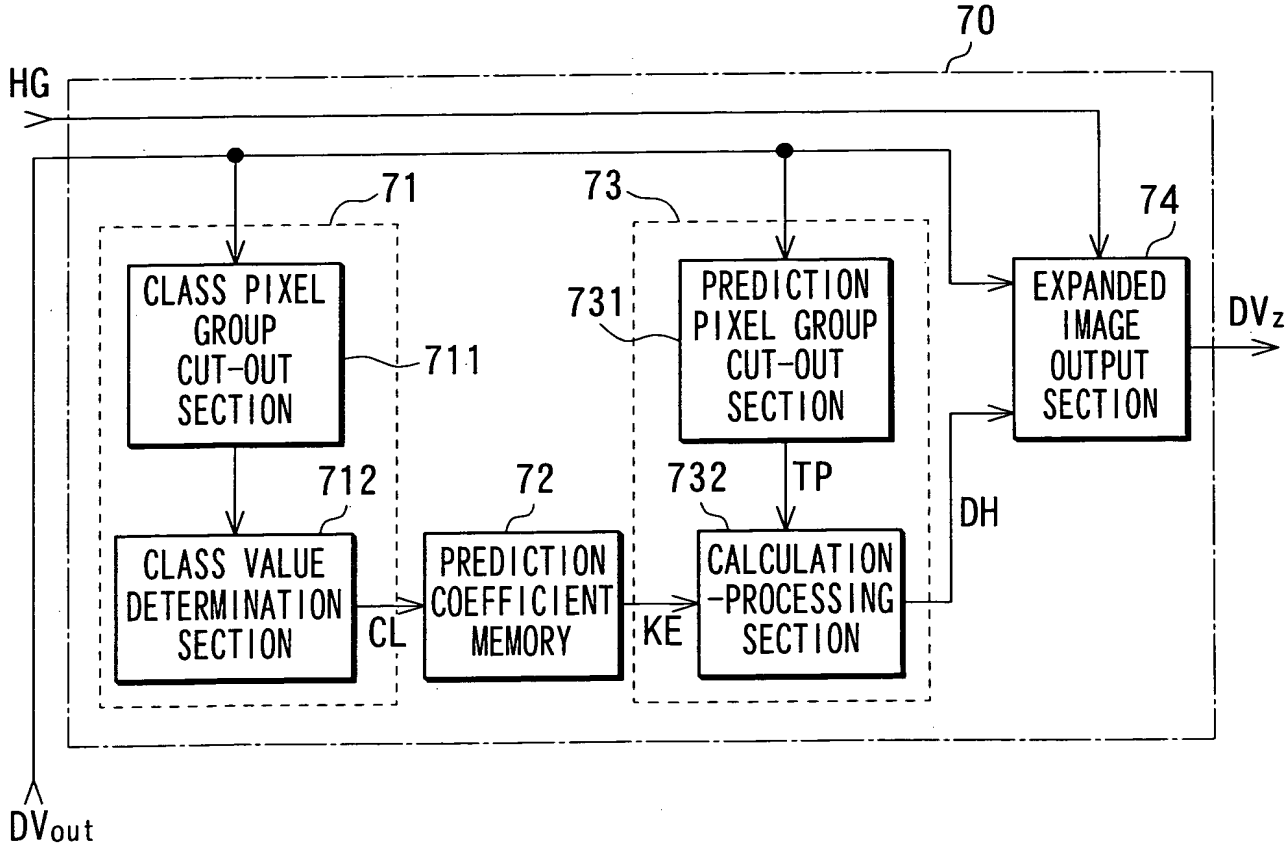

70
HG
71
73
74
CLASS PIXEL GROUP CUT-OUT SECTION
731
PREDICTION PIXEL GROUP CUT-OUT SECTION
EXPANDED IMAGE OUTPUT SECTION
DVz
711
712
72
732
TP
DH
CLASS VALUE DETERMINATION SECTION
CL
PREDICTION COEFFICIENT MEMORY
KE
CALCULATION -PROCESSING SECTION
DVout

FIG. 28

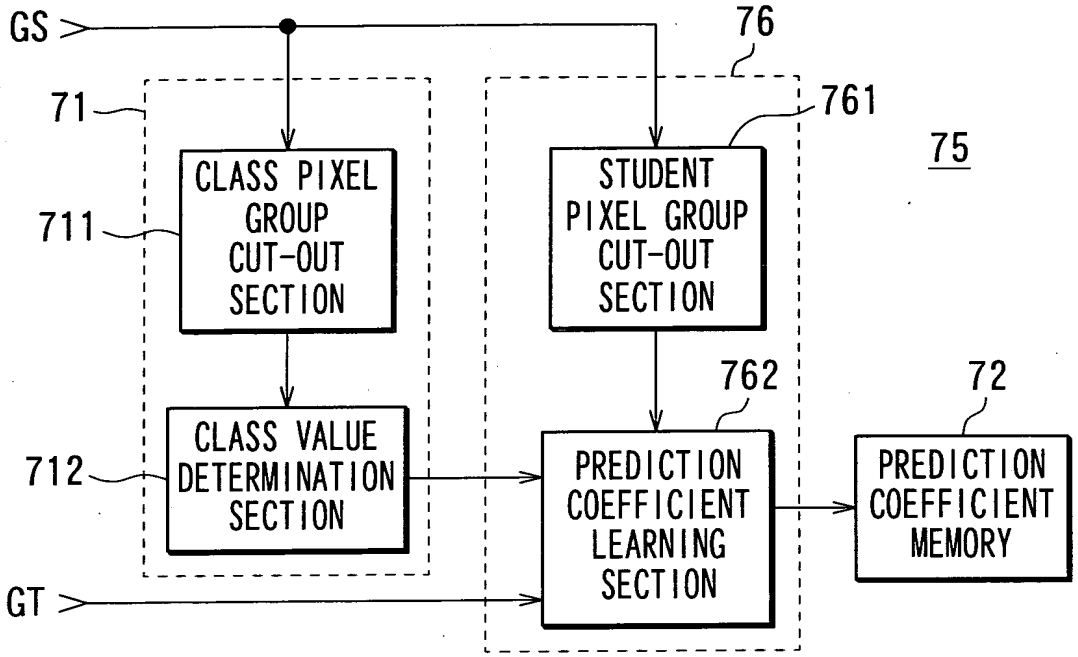

GS
76
71
761
75
CLASS PIXEL GROUP CUT-OUT SECTION
711
STUDENT PIXEL GROUP CUT-OUT SECTION
762
72
CLASS VALUE DETERMINATION SECTION
712
PREDICTION COEFFICIENT LEARNING SECTION
PREDICTION COEFFICIENT MEMORY
GT

FIG. 31

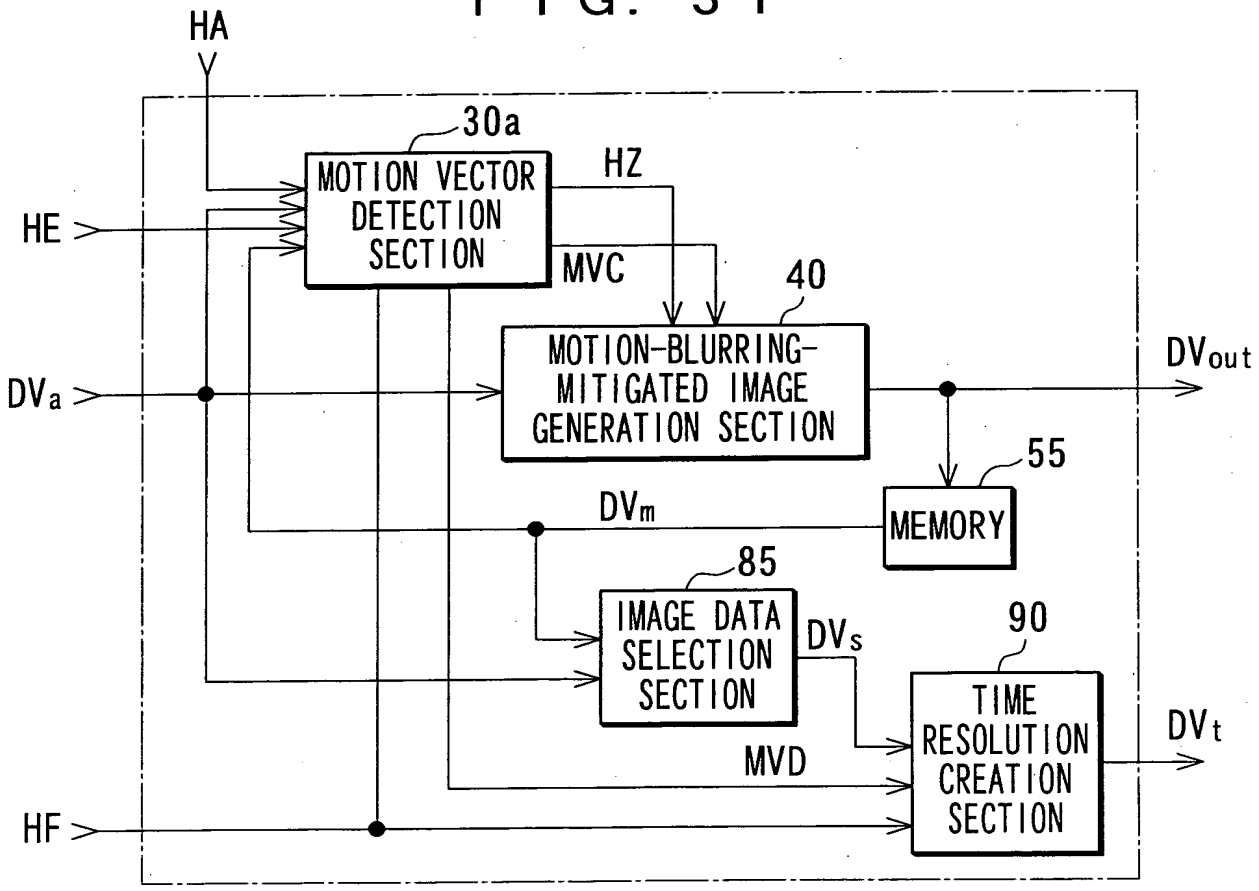

HA
30a
MOTION VECTOR DETECTION SECTION
HZ
HE
MVC
40
MOTION-BLURRING-MITIGATED IMAGE GENERATION SECTION
DVout
DVa
55
DVm
MEMORY
85
IMAGE DATA SELECTION SECTION
DVs
90
TIME RESOLUTION CREATION SECTION
DVt
MVD
HF

FIG. 29

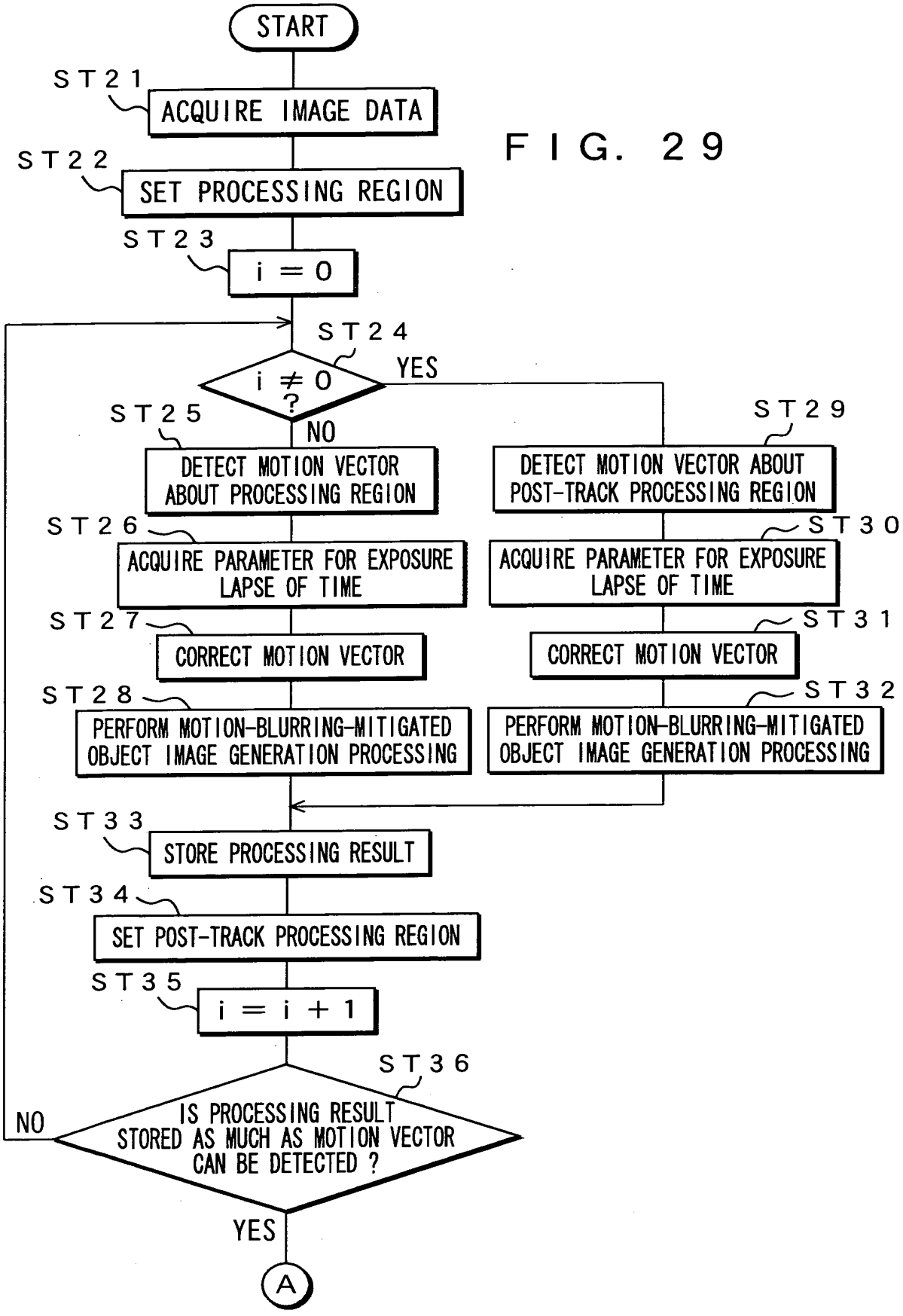

START
ST21
ACQUIRE IMAGE DATA
ST22
SET PROCESSING REGION
ST23
i = 0
ST24
i ≠ 0 ?
YES
NO
ST25
DETECT MOTION VECTOR ABOUT PROCESSING REGION
ST26
ACQUIRE PARAMETER FOR EXPOSURE LAPSE OF TIME
ST27
CORRECT MOTION VECTOR
ST28
PERFORM MOTION-BLURRING-MITIGATED OBJECT IMAGE GENERATION PROCESSING
ST29
DETECT MOTION VECTOR ABOUT POST-TRACK PROCESSING REGION
ST30
ACQUIRE PARAMETER FOR EXPOSURE LAPSE OF TIME
ST31
CORRECT MOTION VECTOR
ST32
PERFORM MOTION-BLURRING-MITIGATED OBJECT IMAGE GENERATION PROCESSING
ST33
STORE PROCESSING RESULT
ST34
SET POST-TRACK PROCESSING REGION
ST35
i = i + 1
ST36
IS PROCESSING RESULT STORED AS MUCH AS MOTION VECTOR CAN BE DETECTED ?
NO
YES
A

FIG. 30

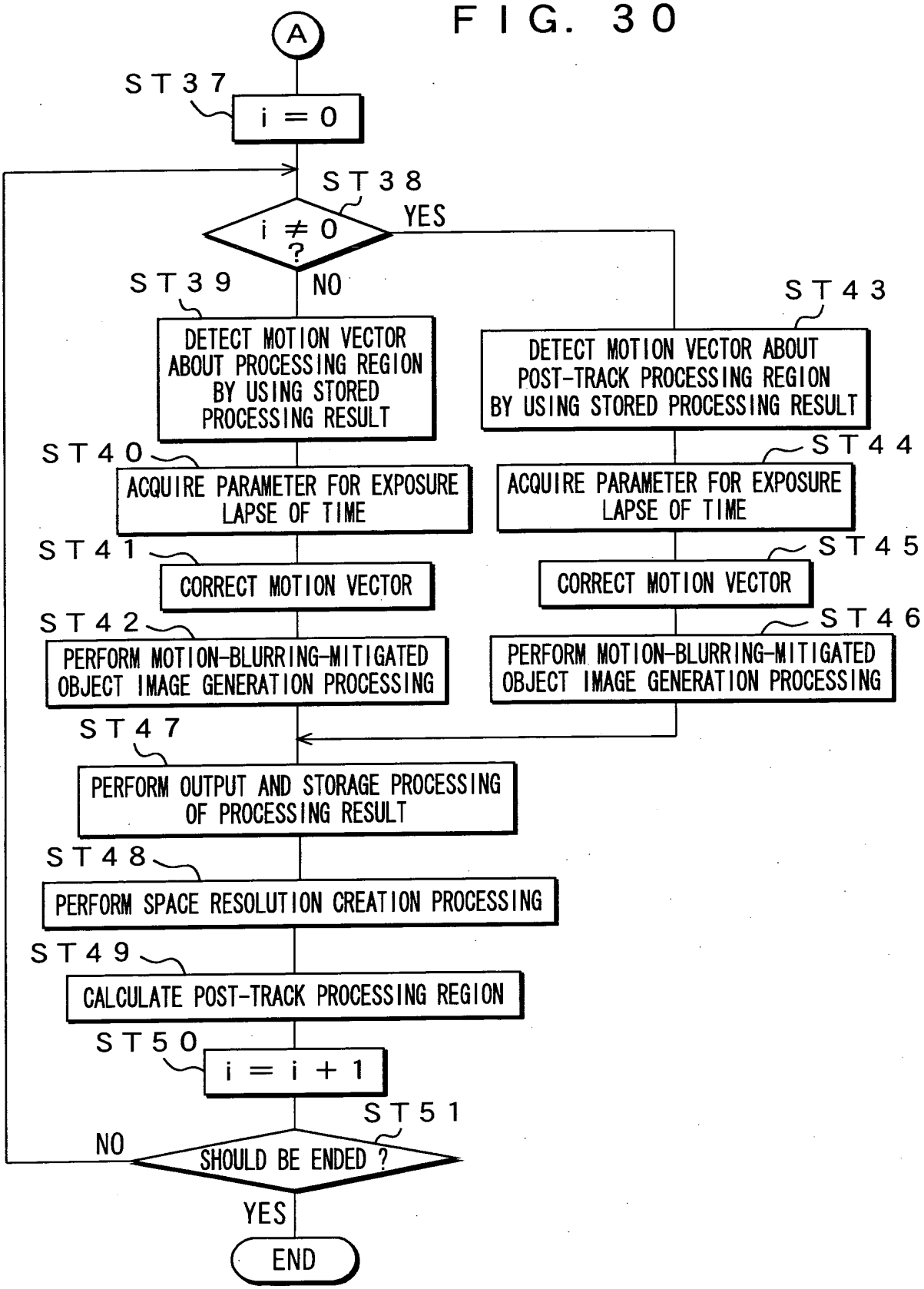

A
ST37
i = 0
ST38
i ≠ 0 ?
YES
NO
ST39
DETECT MOTION VECTOR ABOUT PROCESSING REGION BY USING STORED PROCESSING RESULT
ST40
ACQUIRE PARAMETER FOR EXPOSURE LAPSE OF TIME
ST41
CORRECT MOTION VECTOR
ST42
PERFORM MOTION-BLURRING-MITIGATED OBJECT IMAGE GENERATION PROCESSING
ST43
DETECT MOTION VECTOR ABOUT POST-TRACK PROCESSING REGION BY USING STORED PROCESSING RESULT
ST44
ACQUIRE PARAMETER FOR EXPOSURE LAPSE OF TIME
ST45
CORRECT MOTION VECTOR
ST46
PERFORM MOTION-BLURRING-MITIGATED OBJECT IMAGE GENERATION PROCESSING
ST47
PERFORM OUTPUT AND STORAGE PROCESSING OF PROCESSING RESULT
ST48
PERFORM SPACE RESOLUTION CREATION PROCESSING
ST49
CALCULATE POST-TRACK PROCESSING REGION
ST50
i = i + 1
ST51
NO
SHOULD BE ENDED ?
YES
END

FIG. 32

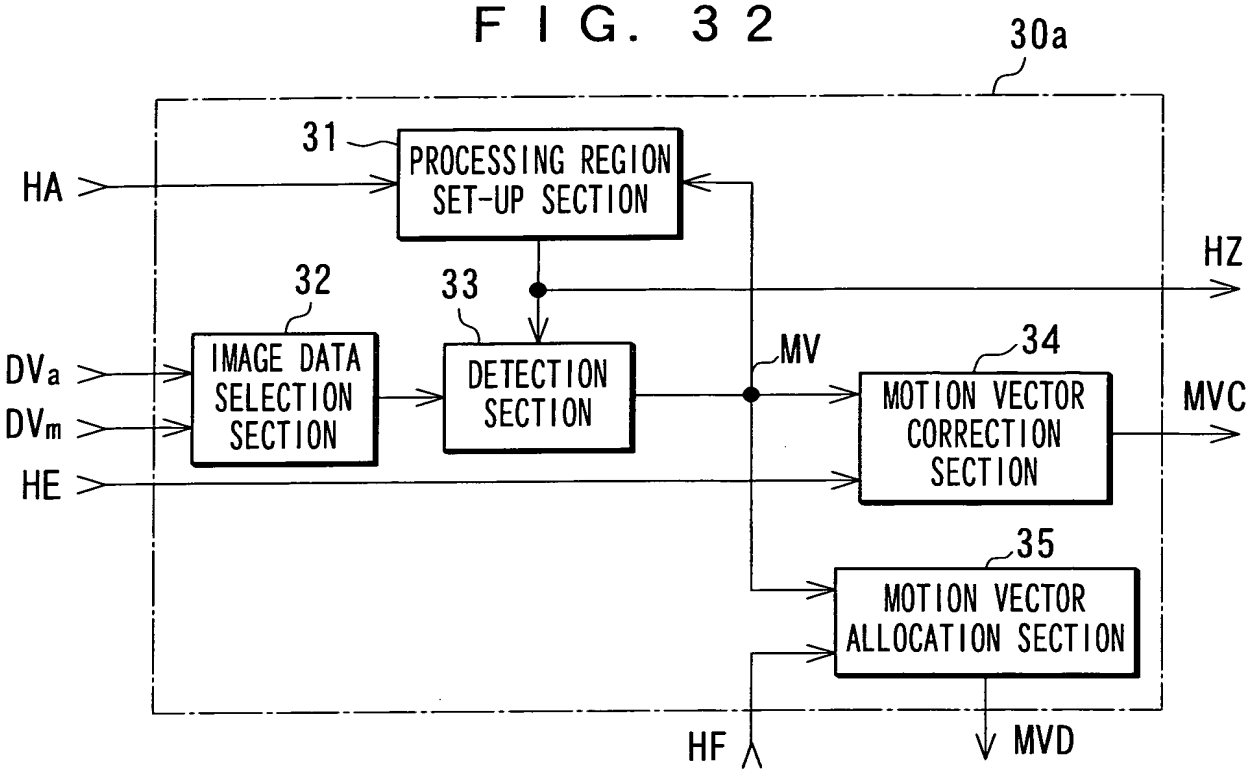

30a
31
PROCESSING REGION SET-UP SECTION
HA
HZ
32
33
IMAGE DATA SELECTION SECTION
DETECTION SECTION
MV
34
MOTION VECTOR CORRECTION SECTION
MVC
DVa
DVm
HE
35
MOTION VECTOR ALLOCATION SECTION
HF
MVD

FIG. 33

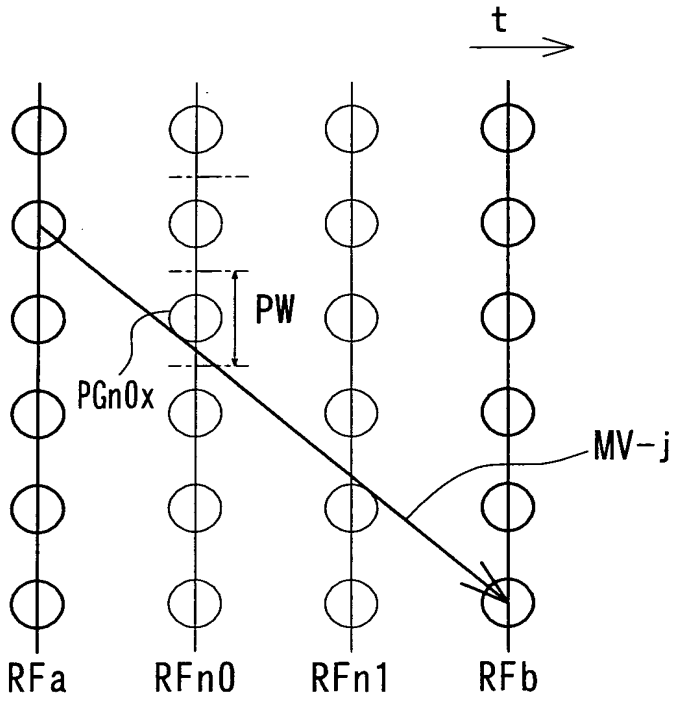

t
PW
PGn0x
MV-j
RFa
RFn0
RFn1
RFb

FIG. 34

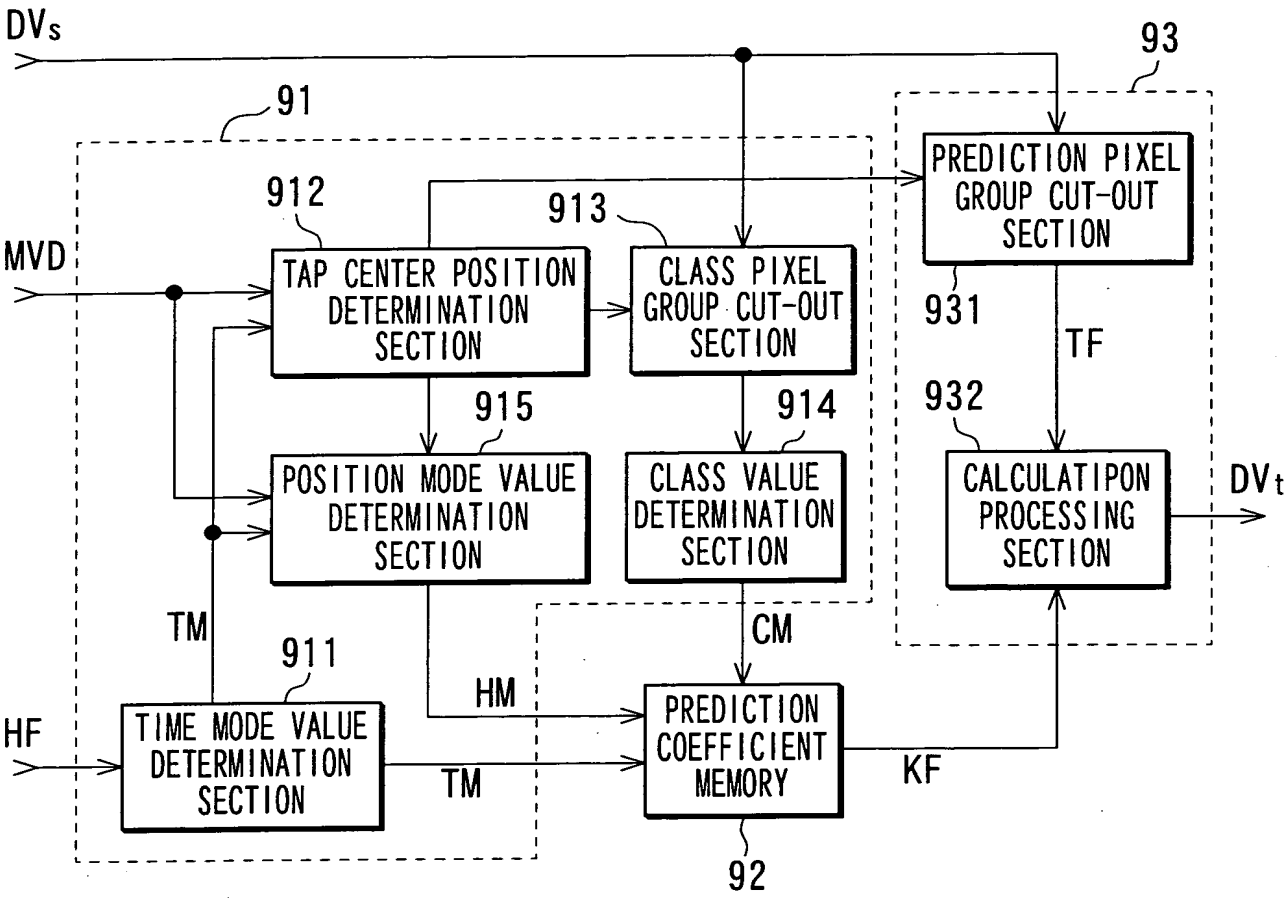

DVs
93
91
912
913
PREDICTION PIXEL GROUP CUT-OUT SECTION
MVD
TAP CENTER POSITION DETERMINATION SECTION
CLASS PIXEL GROUP CUT-OUT SECTION
931
TF
915
914
932
POSITION MODE VALUE DETERMINATION SECTION
CLASS VALUE DETERMINATION SECTION
CALCULATIPON PROCESSING SECTION
DVt
TM
CM
911
HM
HF
TIME MODE VALUE DETERMINATION SECTION
TM
PREDICTION COEFFICIENT MEMORY
KF
92

FIG. 35A

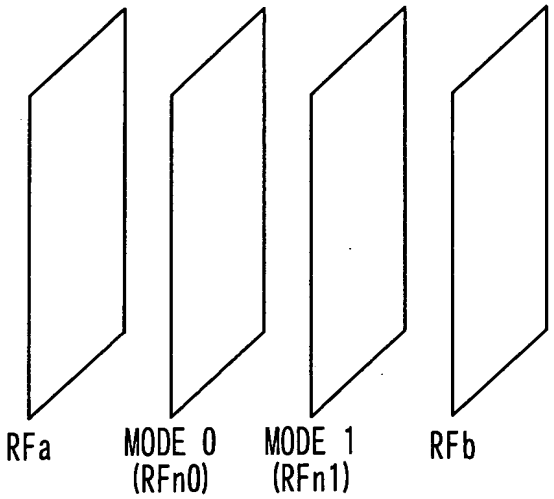


FIG. 35B

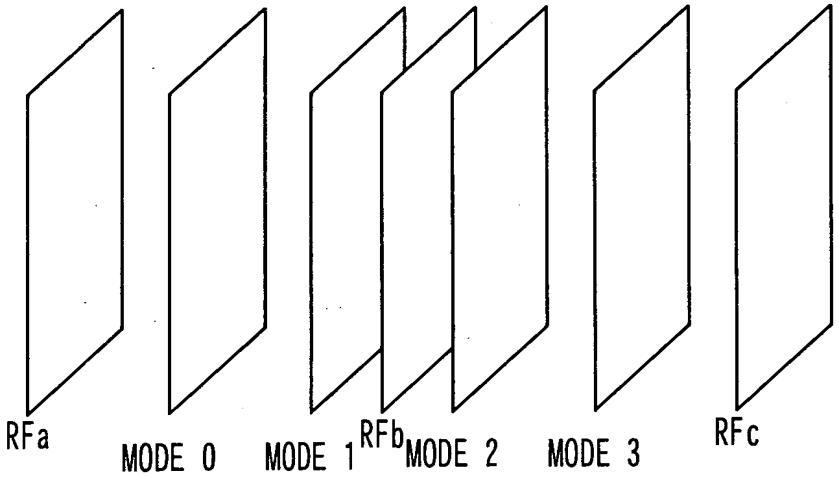


FIG. 36

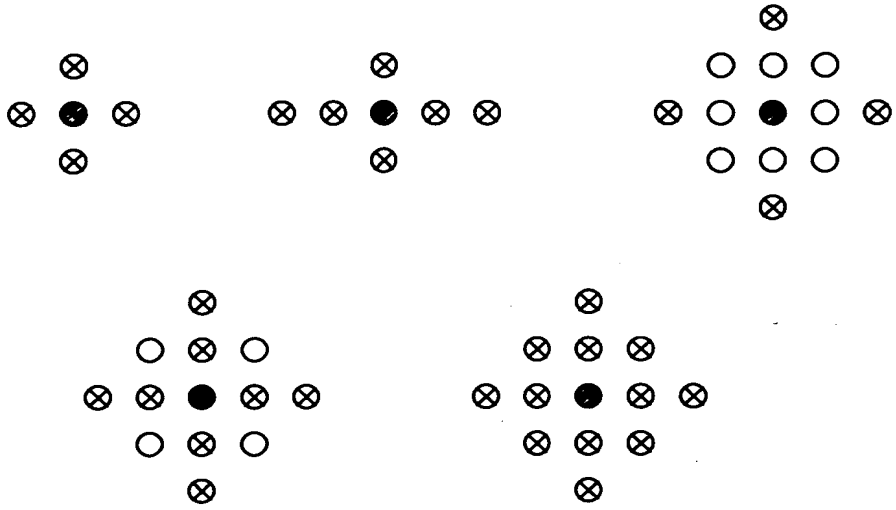


FIG. 37

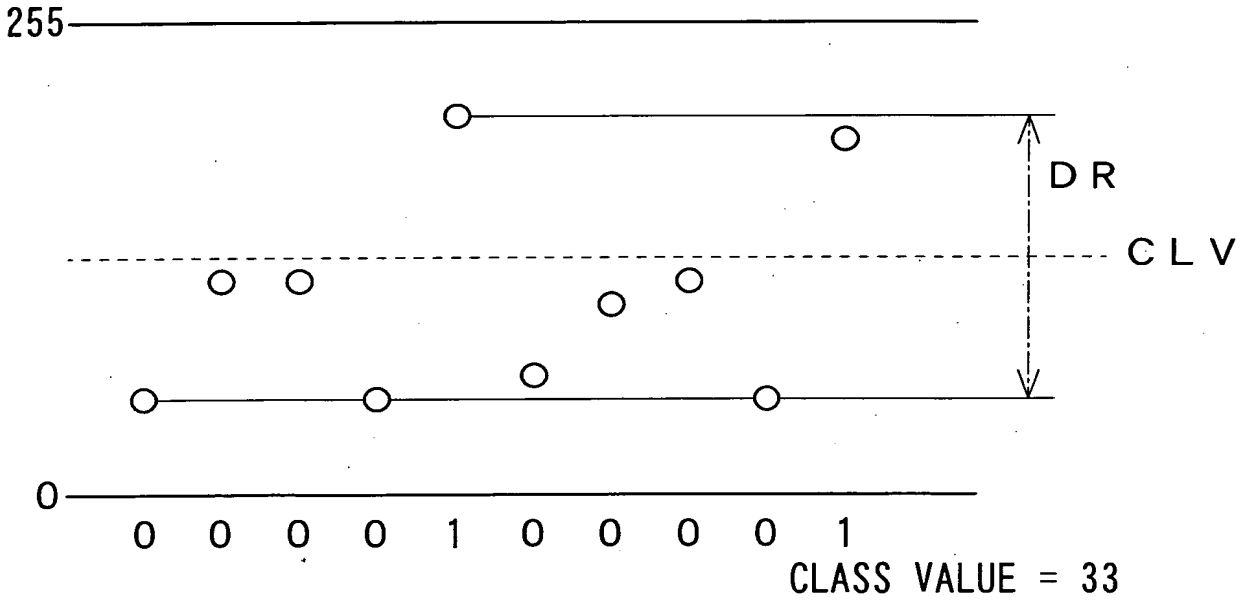


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FIG. 38

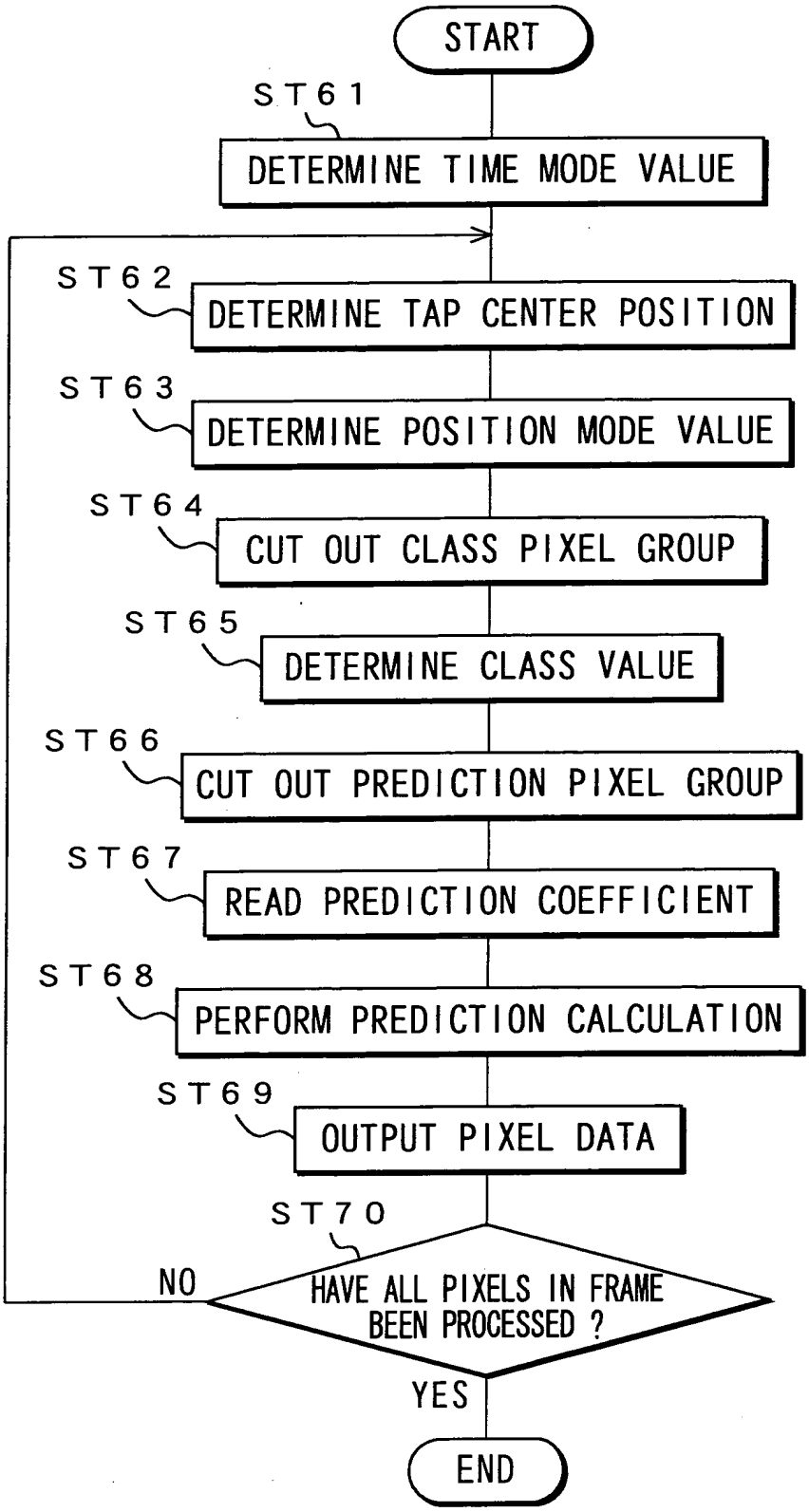


FIG. 39

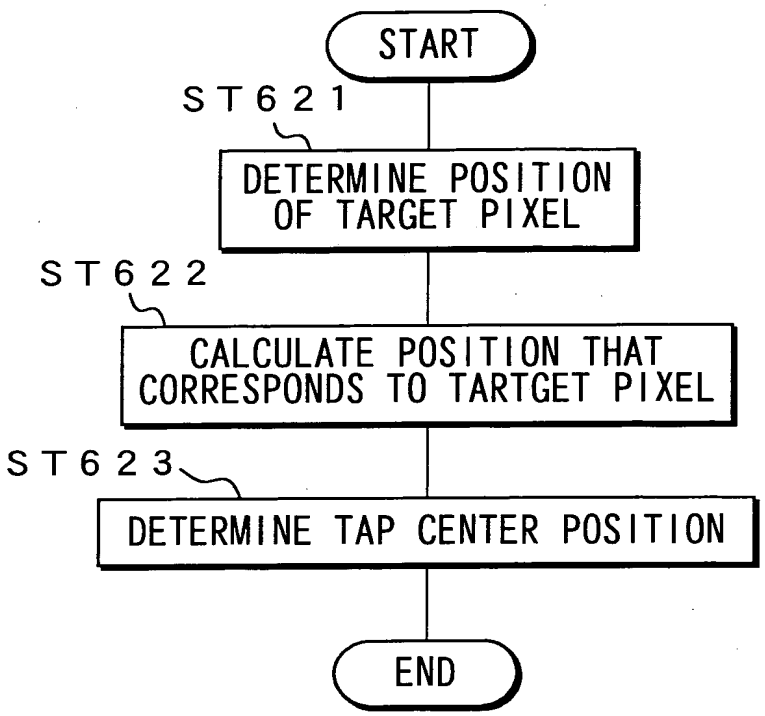

START
ST621
DETERMINE POSITION OF TARGET PIXEL
ST622
CALCULATE POSITION THAT CORRESPONDS TO TARTGET PIXEL
ST623
DETERMINE TAP CENTER POSITION
END

FIG. 40

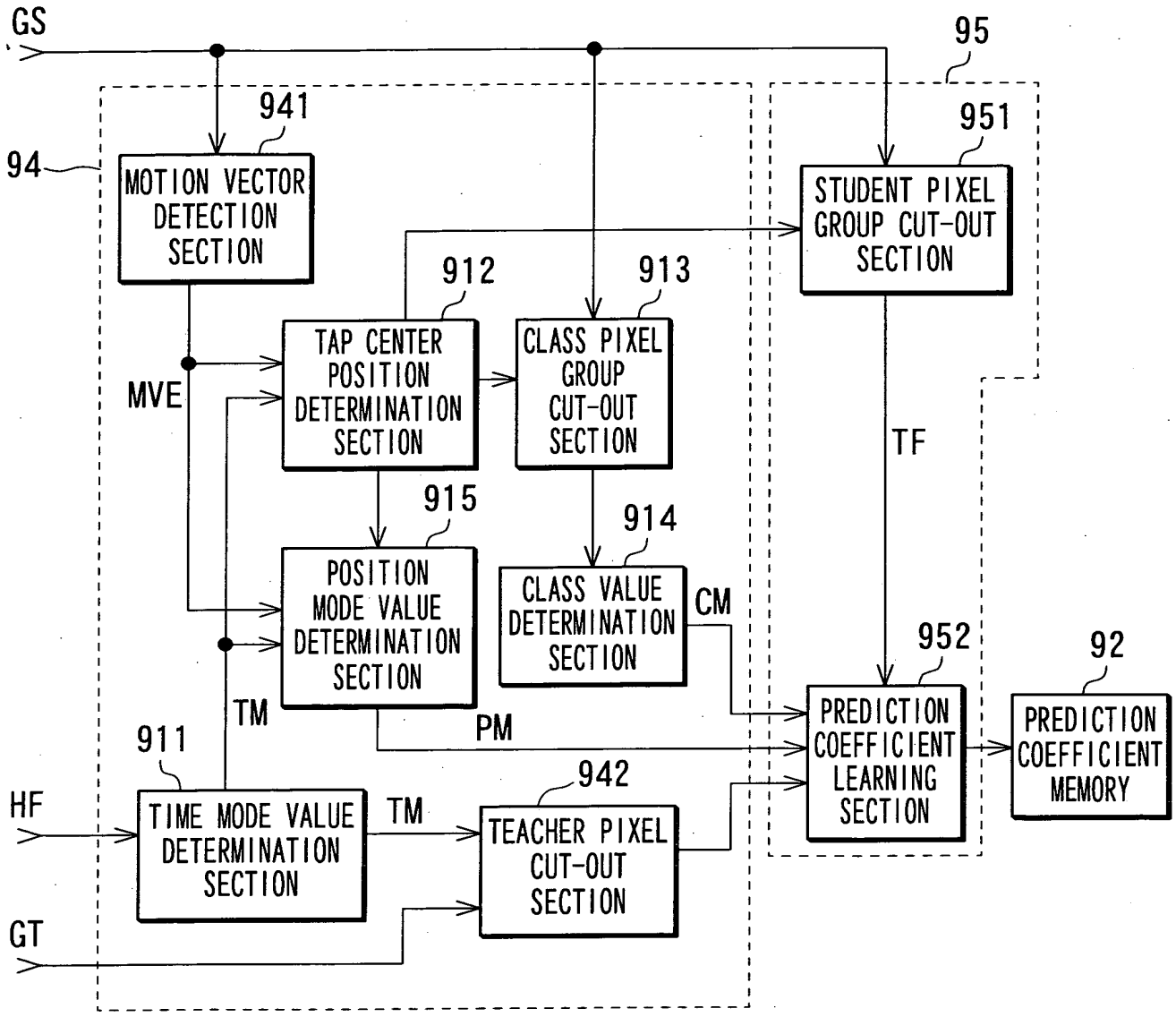

GS
95
941
951
94
MOTION VECTOR DETECTION SECTION
STUDENT PIXEL GROUP CUT-OUT SECTION
912
913
TAP CENTER POSITION DETERMINATION SECTION
CLASS PIXEL GROUP CUT-OUT SECTION
MVE
TF
915
914
POSITION MODE VALUE DETERMINATION SECTION
CLASS VALUE DETERMINATION SECTION
CM
952
92
TM
PM
911
PREDICTION COEFFICIENT LEARNING SECTION
PREDICTION COEFFICIENT MEMORY
942
HF
TIME MODE VALUE DETERMINATION SECTION
TM
TEACHER PIXEL CUT-OUT SECTION
GT

FIG. 41

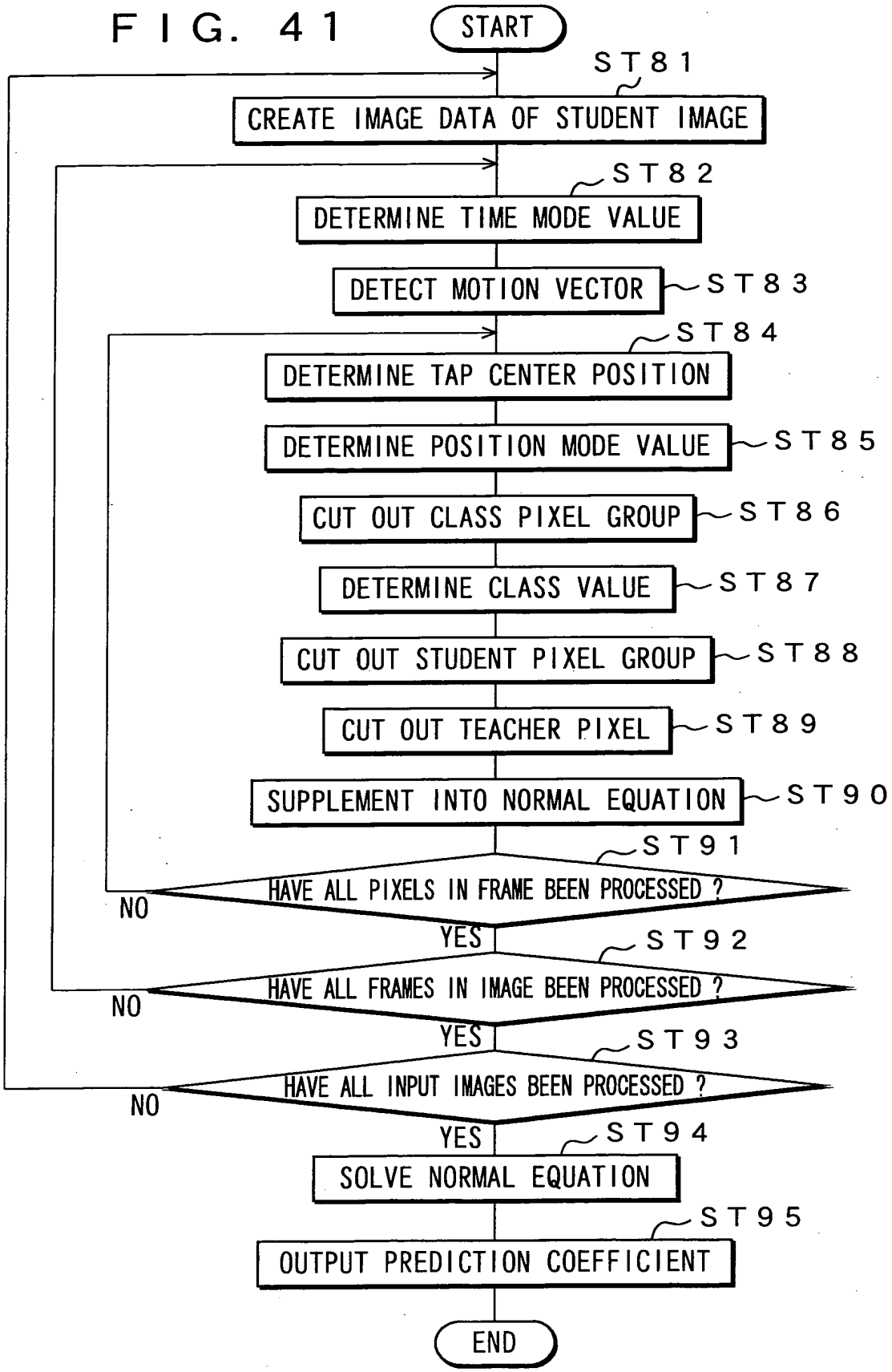

START
ST81
CREATE IMAGE DATA OF STUDENT IMAGE
ST82
DETERMINE TIME MODE VALUE
DETECT MOTION VECTOR
ST83
ST84
DETERMINE TAP CENTER POSITION
DETERMINE POSITION MODE VALUE
ST85
CUT OUT CLASS PIXEL GROUP
ST86
DETERMINE CLASS VALUE
ST87
CUT OUT STUDENT PIXEL GROUP
ST88
CUT OUT TEACHER PIXEL
ST89
SUPPLEMENT INTO NORMAL EQUATION
ST90
ST91
HAVE ALL PIXELS IN FRAME BEEN PROCESSED ?
NO
YES
ST92
HAVE ALL FRAMES IN IMAGE BEEN PROCESSED ?
NO
YES
ST93
HAVE ALL INPUT IMAGES BEEN PROCESSED ?
NO
YES
ST94
SOLVE NORMAL EQUATION
ST95
OUTPUT PREDICTION COEFFICIENT
END

FIG. 42

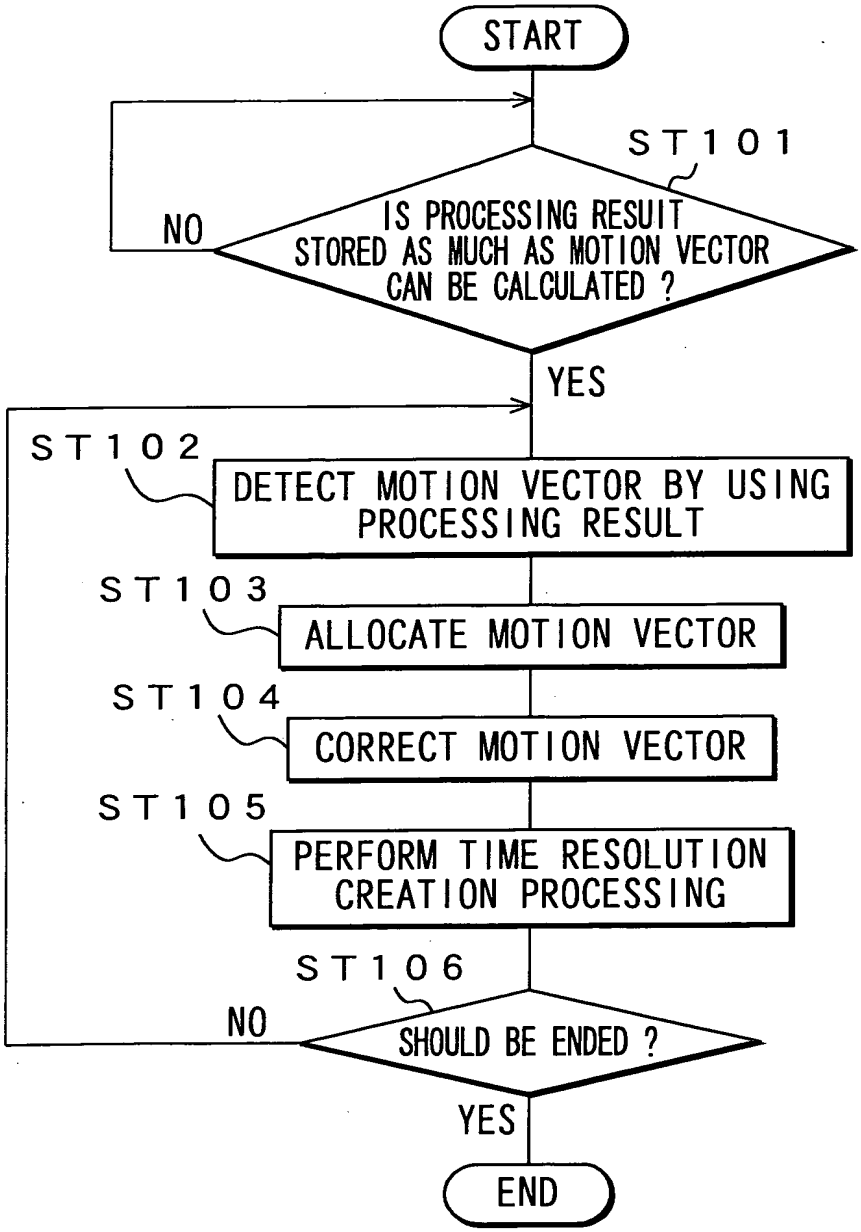
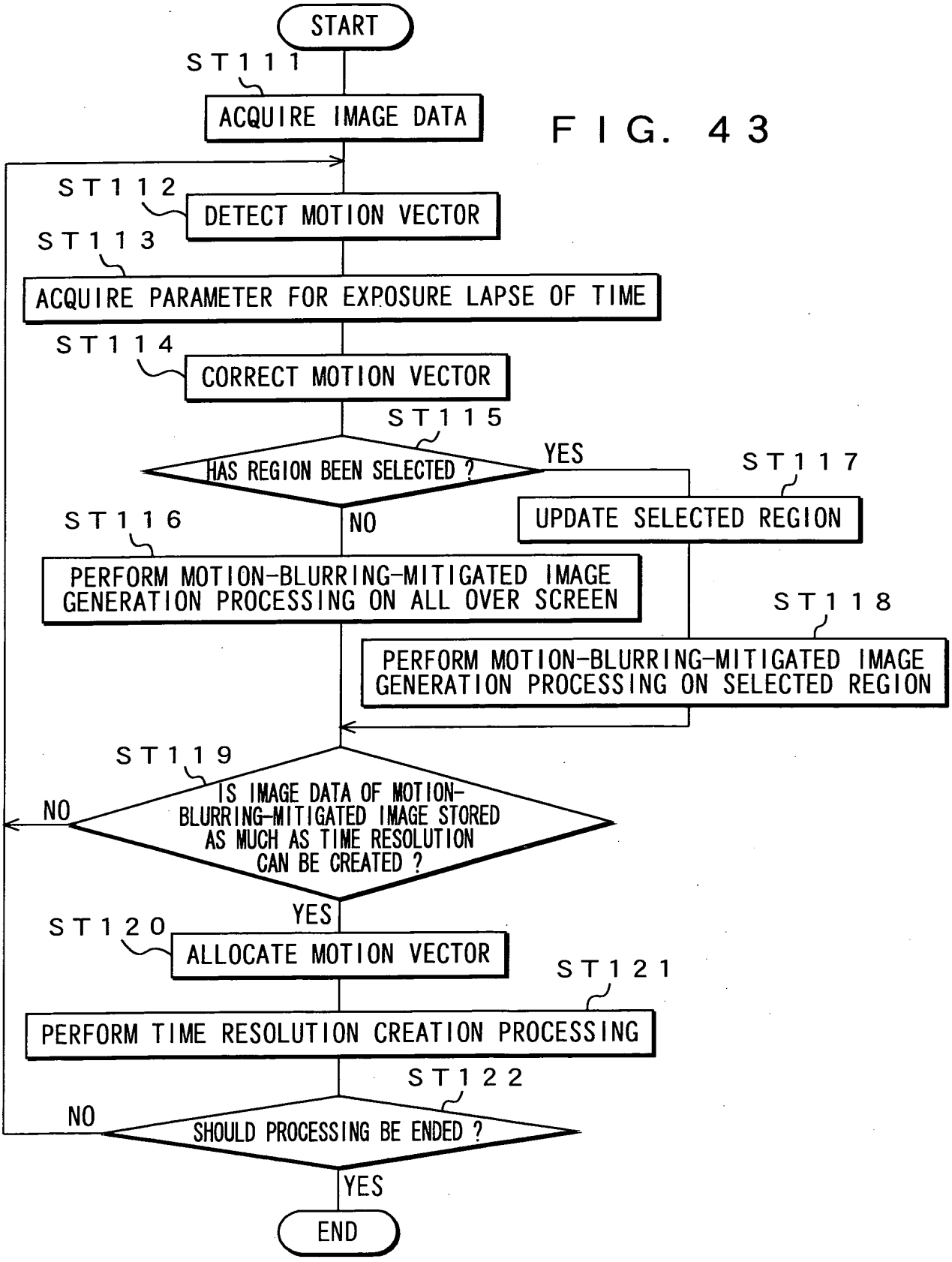

START
ST101
IS PROCESSING RESUIT STORED AS MUCH AS MOTION VECTOR CAN BE CALCULATED ?
NO
YES
ST102
DETECT MOTION VECTOR BY USING PROCESSING RESULT
ST103
ALLOCATE MOTION VECTOR
ST104
CORRECT MOTION VECTOR
ST105
PERFORM TIME RESOLUTION CREATION PROCESSING
ST106
SHOULD BE ENDED ?
NO
YES
END

FIG. 43


START
ST111
ACQUIRE IMAGE DATA
ST112
DETECT MOTION VECTOR
ST113
ACQUIRE PARAMETER FOR EXPOSURE LAPSE OF TIME
ST114
CORRECT MOTION VECTOR
ST115
HAS REGION BEEN SELECTED ?
YES
NO
ST117
UPDATE SELECTED REGION
ST116
PERFORM MOTION-BLURRING-MITIGATED IMAGE GENERATION PROCESSING ON ALL OVER SCREEN
ST118
PERFORM MOTION-BLURRING-MITIGATED IMAGE GENERATION PROCESSING ON SELECTED REGION
ST119
IS IMAGE DATA OF MOTION-BLURRING-MITIGATED IMAGE STORED AS MUCH AS TIME RESOLUTION CAN BE CREATED ?
NO
YES
ST120
ALLOCATE MOTION VECTOR
ST121
PERFORM TIME RESOLUTION CREATION PROCESSING
ST122
SHOULD PROCESSING BE ENDED ?
NO
YES
END